Undergraduate learning at programme level: an analysis of students' perspectives

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UNDERGRADUATE LEARNING AT PROGRAMME LEVEL; AN ANALYSIS OF STUDENTS' PERSPECTIVES

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ABSTRACT

Undergraduate learning at programme level; an analysis of students' perspectives

This research project aimed to understand undergraduate learning at programme level by analysing students' perspectives. Seventy graduates and undergraduates contributed their perceptions of the learning opportunities they encountered while studying Molecular and Cellular Biology at the University of Bath, between 1994 and 2005.

The methodology employed was qualitative, involving open dialogue (face to face and by email) whereby the students' concerns dictated the agenda, rather than those of the researcher. Data are presented in narrative form, intended to convey a rounded picture of the richness and variety of students' perceptions of their learning situations, including lectures, practical classes, tutorials, placements, presentations and projects.

Preliminary research suggested that learning from professional work placements can be significant, even 'special', and placement learning was the initial focus of the project. Research questions crystallised in the following areas: *'What is the nature of placement learning?', 'How does it come about?'* and *'How does it compare with learning from university-based learning opportunities?'*

Preliminary data suggested that undergraduate learning could best be understood through socio-cultural and activity theories of learning (SCAT. Vygotsky, Leontiev and others) but this did not explain the disparity which can occur between intended learning outcomes, envisaged by the University, and the learning which students actually reported. Data from the four year longitudinal study was, therefore, analysed using a framework which was a fusion between SCAT and Theories of Action (comparison between espoused theories and theories in use. Argyris and Schön).

The marriage between SCAT and Theories of Action seems to be an informative approach to analysing undergraduate learning in a variety of learning situations, both at university and on placement. In particular, it seems to reveal why students sometimes reported learning little from potential learning opportunities.

Abbreviations

ASET	Association for Sandwich Education and Training
Biol	Biology
BSc	Bachelor of Science degree
DNA	Deoxyribonucleic Acid
DP	During placement. Undergraduates who contributed data during their placements
G	Graduate. Quotations from graduates
HE	Higher Education
HEFCE	Higher Education Funding Council for England
ILT	Institute for Learning and Teaching
IR	Immediate retrospective. Undergraduates who contributed data on their return from placement
L	Longitudinal. Undergraduates who took part in the longitudinal study
Lab	Laboratory
LTSN	Learning and Teaching Support Network
Masters/ MBiol	The Masters degree referred to in this thesis is an undergraduate Masters degree in Molecular and Cellular Biology designated by MBiol (not by MSc)
MCB	Molecular and Cellular Biology
Mol	Molecular
Mol Biol	Molecular Biology
NCWE	National Centre for Work Experience
PBL	Problem-based learning
PCR	Polymerase Chain Reaction (a method of amplifying DNA)
Practicals	Practical classes, university-based
QAA	Quality Assurance Agency for Higher Education
SCAT	Socio-cultural and Activity theory
SSLC	Staff-Student Liaison Committee
Uni	Undergraduates frequently abbreviate university to ‘uni’.
US	United States of America
ZPD	Zone of Proximal Development (Vygotsky)

CHAPTER 1: INTRODUCTION

I failed my eleven-plus exams. At O-level my exam results were mediocre. I failed my A-level exams at the age of eighteen (despite some inspirational teaching and high predicted grades) and for the next 25 years I thought of myself as something of an idiot. Yet in my forties I passed the same A-level subjects at Grade A and gained a first class BSc (Hons) in Molecular and Cellular Biology. My interest in education is, therefore, keen and personal but it took a while to manifest. With retrospect, two matters in particular set me thinking about undergraduate learning. Firstly, I remember being told, as a first year undergraduate, that there were no such things as poor lectures, only differing lecturing styles; I thought this arrant nonsense, as some lectures seemed to aid student understanding while others caused confusion. Secondly, spending my third undergraduate year on placement, and learning a great deal from doing so, made me focus on the differences between placement learning and learning from university-based learning experiences.

This thesis describes my efforts to gain some understanding of undergraduate learning from graduates' and undergraduates' descriptions of their experiences. The approach I adopted (which was naturalistic and inductive) was very far removed from the scientific methodology I was accustomed to but I undertook this research with rigour and believe that the picture I have pieced together and tried to interpret is an honest and rounded representation of the learning experiences of participant students.

I came to the University of Bath as a mature student in 1994, on a sandwich degree programme for Molecular and Cellular Biology (MCB), and graduated in 1998 at the age of 49. Learning gave me a tremendous buzz and I found the degree course both challenging and rewarding. I learnt very little, though, about learning itself and some of what I did was rather negative. Some lecture courses, and the majority of practical classes, taught me almost nothing and so I quickly learnt that the connection between teaching and learning can be tenuous and that sometimes there was clear disparity

between the intended and actual learning outcomes from undergraduate units.

I learnt too that some elements of a degree programme, particularly the final year, can be a nightmare of high workload, assessment deadlines and stress; I had hoped to consolidate and deepen my knowledge gained in the previous three years but, sadly, I remember very little of final year except feeling pressurized. The year spent on professional work placement was, by contrast, highly beneficial to my learning and I began to wonder why. It was hard work and at times stressful but also enjoyable, rewarding and productive leading as it did to much deeper understandings of my subject and myself.

This thesis describes my efforts to understand undergraduate learning, from the experiences of other MCB students. Some of the research focussed particularly on work-based placement learning and some on university-based learning. I came to realise that students' experiences could be very different, sometimes because of circumstances and sometimes because of students' own perceptions, and to understand something of the processes involved in learning, its promoters and inhibitors. This first chapter outlines the background to the research and summarises the specific aims underlying it.

The University of Bath and its Department of Biology & Biochemistry

The University of Bath occupies some 200 acres on a hill overlooking the World Heritage City of Bath. The city is famous for its Roman Baths and Georgian architecture, for its Music Festival and the Theatre Royal, and is home to Museums of Costume, the Royal Photographic Society and, close to the University, the American Museum.

The University was established in the 1960s as a compact, purpose-built development and is one of the smaller universities in Britain, with approximately 10,000 students. It has a high reputation for the quality of its degree programmes and its research, and is the United Kingdom Sports

Institute for the South West. All these factors combine to make the University of Bath an attractive option for undergraduates.

The Department of Biology & Biochemistry describes itself as an ambitious, research-based Department, rated grade 5 in the 2001 HEFCE Research Assessment Exercise, with a commitment to high quality teaching for its undergraduates; it achieved top marks of 24 in its 1999 Quality Assurance Agency for Higher Education (QAA) Teaching Quality Assessment. The Department has run a professional placements scheme for many years and continues to be a leading UK provider of integrated sandwich course degrees in Biology and Biochemistry, arranging around 150 student placements each year in commercial, government and academic institutions. Its graduates have a good employment record, with 90% employed, engaged in research or studying for higher degrees within six months of graduation.

Molecular and Cellular Biology Undergraduate Degree Programmes

Molecular and Cellular Biology is a rapidly advancing area of biological sciences; new techniques are being employed to study structure and function in biological systems at a cellular level. MCB is being applied to questions in molecular genetics, developmental biology, cancer research, immunology, parasitology, cellular communication, neuroscience, biotechnology and many other related areas. Cloning and genome projects have raised public awareness of molecular biology in recent years.

The MCB programme at Bath began in the early 1990s. The usual entry requirements for students are A-level grades ABB, including Biology and Chemistry (or equivalents) and the annual intake is between 20 and 30 students. The first and second years involve students in lectures, tutorials and practical classes and the final year involves lectures, student seminars and some practical classes, together with an individual practical project. The degree course can either be taken as full-time over three years or (provided the student is able to satisfy certain academic standards) as a four-year thick sandwich course with twelve months of professional placement between year

2 and the final year, *i.e.* placements are an optional part of the degree course. Some students enrol for a sandwich course from the start while others may transfer at the end of their first year. For those who intend to enter a research career, and have demonstrated their keenness and academic ability, the opportunity to study for an undergraduate Masters degree (MBiol in Molecular and Cellular Biology) was introduced in 2001/2; undergraduates on the Masters programme undertake additional work, including distance learning while on placement, and their placements must be research-based.

The MCB programme specification is given in full in Appendix 1. The educational aims, structure and content of the entire programme are, however, given on the following page.

EDUCATIONAL AIMS OF THE PROGRAMME:

We aim to:

- offer a stimulating environment that will encourage students to develop their full academic potential
- instruct our students in ways of approaching and analysing problems, so that they can reach considered and appropriate conclusions, and communicate these conclusions to others
- equip students with skills that are both of value to future employment in some area of biology and transferable to other avenues of employment
- provide conceptual and factual knowledge of core aspects of biological sciences and supporting disciplines and explore the boundary of knowledge in selected areas

An additional aim of the MBiol is to:

- prepare graduates to be able to undertake a professional, research-related career in biology with the minimum of further formal training

STRUCTURE AND CONTENT OF THE PROGRAMME (inc. potential stopping off points):

Year 1
The three programmes in molecular & cellular biology follow a common first year with units covering areas of biochemistry, cell biology, diversity, introductory organic chemistry, cell & molecular biology, genetics, human physiology and either further biological diversity or general chemistry. There are also two half units in skills & techniques. Units have a credit value of 6, with each student taking 60 credits over an academic year that consists of two 15-week semesters. Additional units in education, management or a foreign language may be taken.

Year 2
The programmes have a common second year, with students again taking 60 credits. All courses have two mandatory half units, Directed studies, and three mandatory 6 credit units, DNA (making , breaking & disease), Cell biology 2 and Practical molecular biology. A further 6 units are selected from options available including genes & development, physiology & immunology, plant pathology, plant biochemistry, plant biotechnology, bacteriology, microbial genetics, statistics, enzymology, physical biochemistry & proteins, protein purification, cellular neurobiology and genes & development practicals. MBiol students will also do a pre-placement course in bioinformatics.

Year 3
Optional professional placement year for BSc students involving a minimum of 44 weeks experience within a professional setting. Mandatory professional placement for MBiol students involving a minimum of 44 weeks experience in a research environment. Additionally there are two units, problem solving and critical reading, to study whilst on placement.

BSc Final Year
Mandatory in the final year is an investigative project and a unit on data interpretation. The remaining 42 credits are selected from the units available, which build on and develop from those offered in year 2. Most units are at H level, though a limited number of M level units are also available.

MBiol Final Year
Mandatory in the final year is an M level research project and units on research training and integrating biological concepts. The remaining units (36 credits) are chosen from a range of options, which build on and develop from those offered in year 2.
Most or all of these units are M level.

Placements

National guidelines on placements come from two sources:

In July 2001 the QAA produced, as part of its *Code of Practice for the Assurance of Academic Quality and Standards in Higher Education*, Section 9: Placement Learning. The Code is in response to the Dearing Report (1997). The completed Code is intended to help institutions assure the academic quality and standards of their programmes, awards and qualifications. It is concerned with 'arrangements made for learning that is a planned and intended part of an academic programme' and states that 'an effective placement learning opportunity is one in which the aims and intended learning outcomes are clearly defined and understood by all parties'. It goes on to say that 'The intended learning outcomes … may be highly specific, for example the development of practical skills and competencies … or more general, for example the development of an understanding of the cultural or employment context of an academic discipline' (pp 1-4).

Another *Code of Good Practice for the Operation of the Placement Element of Sandwich Courses in Higher Education* was produced in March 2001 by the Association for Sandwich Education and Training (ASET), in association with the National Centre for Work Experience (NCWE). This Code states that 'sandwich courses may usefully be regarded as a subset of work-based learning, being distinguished primarily by being a substantial and integral part of a defined course of study' and that the student embarks on his or her placement 'with the objective of consolidating and complementing the academic learning.' It goes on to say that 'in addition to this, the objectives for the course and student are likely to include:

- Develop student's personal and enterprise skills such as communication, teamwork, problem solving, decision-making, initiative and creativity.

- Implement some academic aspects of the course of study and lay experiential foundations for the assimilation of academic study following the placement.
- Enhance students' awareness of the work environment in professional, social and behavioural contexts, thus improving students' employability.
- Assist students in self-awareness and development of their individual career planning.'

The document also states that 'Even a career decision along the lines of "not that employer, not that type of work" can be constructive if genuinely informed' (pp 2-5).

Professional placements for MCB students at Bath are usually for one year but occasionally for two consecutive six-month periods in different places. The Placements Office arranges these within a broad range of companies and institutions, and a wide range of areas of Molecular and Cellular Biology. The majority of placements are in the United Kingdom, although there are increasing opportunities abroad. Payment is usually offered except, for example, for work in a cancer charity or in a less-developed country. The nature of the work varies hugely but most placements are based in laboratories.

The Department has had a good reputation for the quality of its placements and its placement students. It is not uncommon for placement work to be acknowledged in research papers or for students to receive offers of employment or postgraduate studentships from their host institutions.

<u>The MCB Placement Process</u>

Students who consider applying for the optional sandwich year attend a meeting with the placements team at the end of their first year. They are given general information about placements (including the pros and cons of doing one, and the rights and responsibilities of all involved) and they are able to ask questions. Students have the summer vacation period to decide

whether or not to apply and, if they opt to do so, they complete a simple form outlining the type of work they would like to be involved in while on placement.

Assuming the student has achieved satisfactory first year results, they are interviewed very briefly at the start of their second year; their preferences are discussed and their questions answered. They are also invited to attend a Poster Day where students returning to university for their final year display posters of the work done during their sandwich year; this can be an opportunity for prospective placement students to ask questions of those recently returned from placement.

When placement opportunities have been identified they are usually 'advertised' on a notice board and some background information is given. This may include web pages and/or email addresses where students can find out more details. Students can express their interest in particular placements by signing up for them and details of suitable applicants (*Curriculum Vitae* and tutors' references) are sent to prospective employers, together with completed application forms if required. United Kingdom institutions select their placement students by interview. In the case of foreign employers, where face-to-face interviews would be difficult and expensive, most rely on the recommendations of the Department.

Students are asked to maintain contact with the Department while on placement, especially if they have any problems. All students on placements in mainland Britain are visited by a member of staff during their sandwich year. Those on foreign placements are not usually visited but may be if a member of the academic staff is able to combine a placement visit with some other activity.

At the end of their placements students write a 20-50 page report of their work, usually in the style of a scientific paper, and present a poster to staff and students. They also complete a feedback sheet about both the work and the social/domestic aspects of their placement. Students are assessed by

their placement supervisor and by their academic tutor, who reads the report and holds a discussion with the returning student.

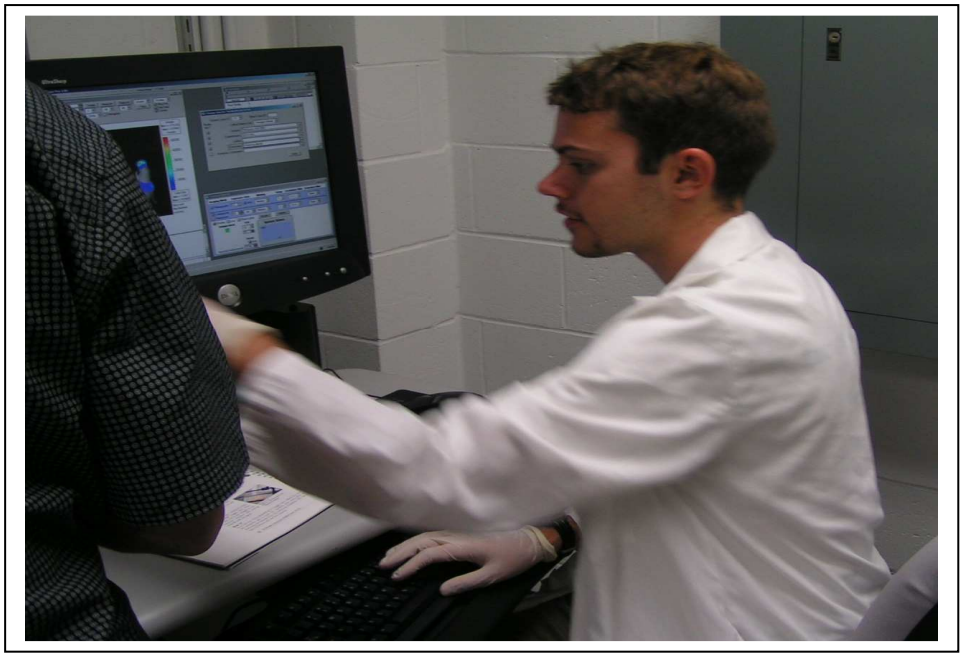
A Brief Description of Laboratory-based Placement Work

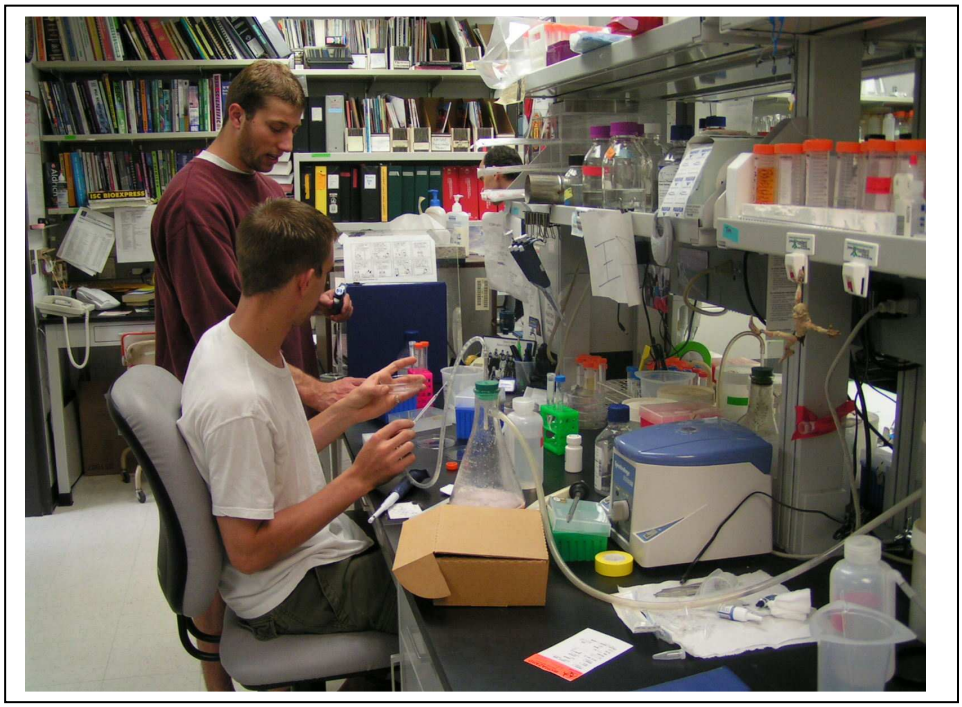
Laboratory-based placement work is similar, in some respects, to university-based practical classes. It involves students in practical work at laboratory benches where they wear white coats and use equipment designed to produce accurate and reproducible scientific results. The practical techniques employed in this type of placement work are many and varied, each using some properties of specific biological components (e.g. molecular size or electrical charge) to identify them and their biological function.

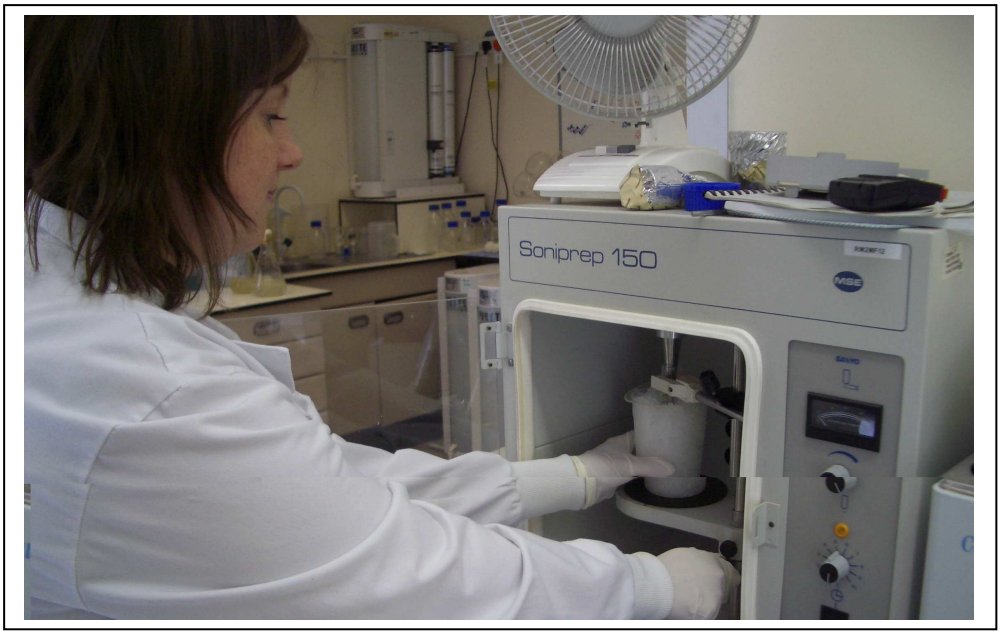
Cells can be isolated and incubated then ruptured so that their constituents can be separated and purified. Large molecules, like proteins and deoxyribonucleic acid (DNA), can be subdivided into specific fragments, by enzyme action, and these can be multiplied (by cloning or polymerase chain reaction, PCR) to yield enough material for analysis in a variety of ways. Analytical methods include X-ray crystallography, microscopy, chromatography, gel electrophoresis, radio-ligand labelling and fluorescence. Similarly, intact living tissues can yield information on biological processes by methods which make visible and measurable changes which occur within cells over time.

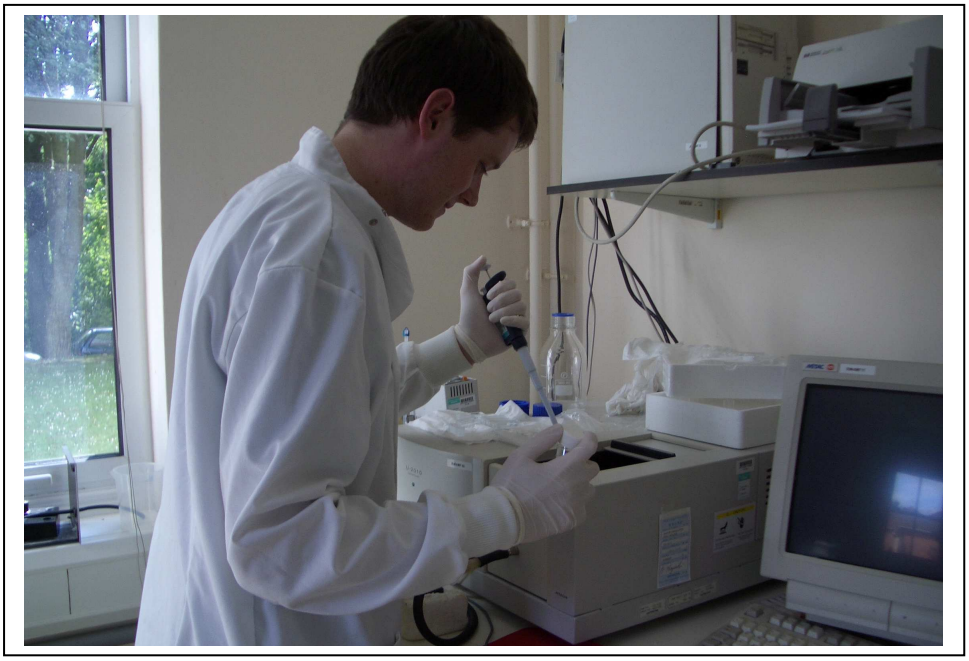
Practical work, therefore, may involve making up solutions of appropriate composition and concentration, the use of pre-prepared kits and standard protocols, the use of often complex laboratory equipment, use of a-septic techniques, awareness of and adherence to good laboratory practice and heath and safety regulations, the ability to perform mathematical calculations, data interpretation skills, IT skills, experimental design and the use of analytical and creative thinking.

Below are a few photographs which show students at work on placement.









As mentioned above, placement work is assessed by written report and poster presentation within the Department and, to a much lesser extent, by supervisor evaluation. Assessment forms part of the final mark for the Masters degree or, for BSc (Hons), placement work is accredited by a certificate issued alongside the degree.

More Personal Background (including placements)

My own placement year consisted of two, six month placements. The first six months were spent in the Molecular Genetics laboratory of Southmead Hospital in Bristol, researching aspects of Hurler's syndrome and cystic fibrosis. The second six months were spent in a Neuropharmacology laboratory at the Institute for Behavioral Genetics of the University of Colorado in Boulder, researching a subset of nicotinic acetylcholine receptors in mouse brain regions.

After graduation I spent two years working in a postgraduate medical research laboratory before returning to the Department of Biology & Biochemistry as Placements Officer in 2000. During my time in that role I continued to observe the changes that placement experiences can have on

students; it was quite common to be told 'I have learnt more in two weeks on placement than in the previous two years!' (This quotation was from a Biochemistry student in an email dated 26 September 2002). Such comments fuelled my desire to understand more about the interesting phenomenon of placement learning and led me into this research (and later into work as a Research Officer with the Department of Education).

The Biology & Biochemistry Department supported my decision to undertake postgraduate study involving their students and the Head of Department gave his permission for the Department to be named in this thesis (JMWS, 28 October 2004). The research was not, however, sponsored by them, it was self-funded. The research was performed at the University of Bath but not by or on behalf of the University.

Research Aims

The aim of the research is to gain a better understanding of undergraduate learning, including placement learning, from student experiences of their degree programmes, and to identify factors which promote or inhibit student learning. The study confined itself to graduates and undergraduates of Molecular and Cellular Biology.

A review of the literature (Chapter 2) revealed a body of evidence suggesting that students learn surprisingly little from conventional teaching methods employed in higher education (HE) – from lectures, reading, tutorials and practical classes - despite many recommendations on how to increase what students gain from their university-based courses. Some sandwich students do, however, appear to learn so much more from their placement experiences where they receive very little in the way of direct, formal teaching. Why should this be so? In what ways is placement learning different and how does this learning come about? Literature on placement learning (Chapter 2) tends to concentrate on skills and competences; if learning takes place at higher levels this has been largely ignored.

Students vary greatly in their background, experience, perspectives, commitment, innate ability and so on. Their experiences of university are therefore very variable. There is huge variety in the nature of work they do on placement, the type of host institution and the nature of institutional culture and, of course, there is as much variety among placement supervisors as there is in students. Yet, despite all these variables, the vast majority of students say they benefit from being on placement. Why? A few students, I was to discover, gained very little learning from their placements. Why should this be? The initial mass of questions began to crystallize in the following areas:

- What is it that students learn from placements and what is the nature of their learning?
- What is involved in the process of learning from placement experiences?
- What is it about a placement that helps to bring about such learning?
- How does placement learning compare with learning from university-based aspects of the MCB course?

It was my intention to provide a broader understanding of the learning afforded by placements than the skills and competences approach taken by many writers on placement learning (Chapter 2). In addition, I believed that comparison between placements and university-based learning opportunities might suggest possible areas for programme enhancement at the local level and, more widely, contribute to our theoretical understanding of learning in HE.

The Project in Brief

In order to find out about undergraduate learning, I decided to study a group of undergraduates during their three (non-placement) or four year (with placement/sandwich) degree programmes. Initially, though, I wanted to find out whether other students found their placements to be significant learning experiences and to gain a quick overview of the MCB programme from the

perspectives of others; to this end, I undertook three supplementary studies in addition to the main longitudinal study.

As an MCB graduate I had the opportunity for research with my own cohort of graduates, who responded to a questionnaire and provided their recollections of the MCB programme run between 1994 and 1998, when the course was fairly new. My shared experience and relationships with these young people, over several years, helped me to interpret their responses and to focus on lines of enquiry to pursue with the other study groups.

My role as Placements Officer provided opportunities to work with more recent MCB students. I was able to enlist the help of three cohorts of MCB undergraduates altogether. Students who did placements in 2001/2002 and 2002/2003 told me about their experiences; they provided a useful snapshot of experiences from thirty-three placements. The main study group came from the 2001 intake and these students took part in the major focus of this research, a longitudinal study over four years, including placement year 2003/2004.

There were a total of 70 participants in all and the data collected covered an eleven year period from 1994-2005. The research was based on an assumption - that students would be able to tell me about their learning - and was entirely qualitative, consisting of group interviews, questionnaires, informal discussions and email contact. Data are presented in narrative form. Analysis involved familiarity with the data, cycles of reflection and reading, and referring back to participants in order to check that my interpretations made sense to them.

There is a second sense in which this is a narrative; I am uncomfortable with the convention which reconstructs a thesis as if it were achieved by psycho-kinesis and have, instead, tried to convey some reality of the process of learning which I underwent while writing it. It felt rather like a journey during which mysterious and wonderful scenery unfolded before me; I have attempted to guide the reader by signposting the route.

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This chapter has introduced the Molecular and Cellular degree at the University of Bath; the MCB programmes are good (although there is always, of course, room for improvement) and the placement option, in particular, can provide a highly beneficial opportunity for undergraduate learning. In addition this chapter has given a brief outline of the research and the nature of the questions addressed. The following chapter will discuss some of the published literature on learning and explain how it helped to inform this research into undergraduate learning from students' perspectives.

CHAPTER 2: LITERATURE REVIEW

This chapter will discuss some of the relevant published literature on learning, including learning in higher education and placement learning. This reading gave me a firm foundation for my growing understandings of learning and, as such, underlies the research. I revisited the literature throughout the project and particularly twice; once when the preliminary data had been gathered (see Chapter 5) and once when data from the longitudinal study had been gathered.

Learning Theories

People have striven to understand the nature of knowledge and the processes of learning since ancient times and continue to do so. Learning theorists have come from various disciplines including Philosophy, Psychology and Biology. 'The fact that so many people have thought about, investigated, and written about the process of learning over the years suggests the complexity of the topic. Learning defies easy definition and simple theorizing' (Merriam and Caffarella 1999, p 248).

At the beginning of the nineteenth century learning was thought of in terms of changes in observed behaviour in response to external stimuli. The Russian physiologist, Ivan Pavlov, believed that organisms are conditioned in such a way that an external stimulus (S) results in a response (R) and demonstrated that an animal can 'learn' to make new responses to new stimuli (Pavlov and Anrep 1927). American psychologist, B.F.Skinner, another proponent of behaviourist theory, demonstrated the importance of reinforcement of desired responses (Skinner 1938). Nowadays the idea that learning involves only external stimuli (inputs) and observed behaviour (outputs) is out of favour and the importance of mental activities in the learning process has been recognised.

The work of Swiss biologist and psychologist, Jean Piaget, has been influential in the shift towards understanding the role of cognitive processes

in learning (Wood 1998). He proposed that the developing child has an innate ability to learn and does so by building or 'constructing' cognitive structures (mental maps, concepts) of increasing complexity throughout its development, moving from a few simple reflexes to highly complex mental activities. There are changes in children's ability to perceive, analyse and remember things throughout childhood. Piaget identified four stages of a child's development and gave approximate ages at which each stage was reached. At every stage the child experiences his or her environment using whatever mental maps he or she has constructed so far. If the experience is a familiar one it is assimilated into the child's existing cognitive structures and mental 'equilibrium' is maintained. If the experience is new or different there is 'dis-equilibrium' and the child's cognitive structures are altered to accommodate the new conditions. In this way the child builds more adequate cognitive structures – it learns. Cognitive theory acknowledges the importance of mental development and processing in learning; learning is no longer seen as merely inputs and outputs. With this in mind, undergraduate learning must depend, in part, on the mental development and mental processes of the individual learner. Piaget's views on the active, constructive nature of development are also known as constructivism.

Constructivists view learning as change or transformation to pre-existing knowledge, rather than as accumulation of facts (Mezirow 1991). According to Mezirow's transformational theory, learning (in this case the perspective is adult social learning) alters people in ways that both they and others can recognise. This type of learning usually begins with a disorienting dilemma (reminiscent of Piaget's dis-equilibrium) that forces the learner into a critical reassessment of assumptions and leads to personal transformation. Lewin (1951) said that to bring about change requires first an unfreezing of the *status quo*, then the change itself and finally a refreezing or consolidation of the new state. Could it be that the disorientation involved in beginning a placement in unfamiliar surroundings facilitates placement learning?

So-called 'culture shock' is the feeling of disorientation associated with a move from a familiar culture to an alien (but not necessarily foreign) one.

The UK Council for International Education (UKCOSA) website describes the process of culture shock as a five-phase 'W' curve of emotional ups and downs which may be experienced by students in unfamiliar learning situations; after an initial honey-moon stage of excitement and stimulation, there may be feelings of confusion, isolation, anger and frustration, before the student comes to accept and to value the differences and similarities between cultures. It goes on to say that 'there are very positive aspects of culture shock. The experience can be a significant learning experience' (p 4). Might culture shock contribute to placement learning?

The Russian psychologist, Lev Vygotsky (1978, 1986) is another major influence on current learning theories (See also Wertsch 1984, Tharp and Gallimore 1991, Wood 1998). Vygotsky worked with his colleagues, Leontiev and Luria, on what has come to be known as Socio-Cultural and Activity Theory. This puts engagement with purposeful work at the centre of learning, learning by doing (Engeström, Miettinen and Punamäki 1999). Vygotskian theories stress the importance of instruction and Vygotsky went so far as to define intelligence as the capacity to learn through instruction. The role of social interaction is seen as critical to learning; these theories have been called social constructivism. Cultural background gives the learner language and other psychological tools so that doing and thinking are mediated through the culture in which the learner is immersed. Culture influences not just what is learnt but also how knowledge is constructed; to call these theories 'socio-cultural' is a better description. One of Vygotsky's major contributions to educational theory was his concept of a 'zone of proximal development' (ZPD), his term for the difference between what a child can do alone and what it can achieve with help from a more knowledgeable or more capable person(s). As Tharp and Gallimore put it 'The cognitive and social development of the child … proceeds as an unfolding of potential through the reciprocal influences of child and social environment. Through guided intervention, higher mental functions that are part of the social and cultural heritage of the child will move from the social plane to the psychological plane, from the inter-mental to the intra-mental, from the socially regulated to the self-regulated' (1991, p 44).

The nature of support given to the child by an adult has been called 'scaffolding' and effective tutoring relationships are those in which the adult gives more help when the learner is struggling with the learning task and less as they become more able (Wood and Wood 1996, Tharp and Gallimore 1991). How is placement learning affected by the culture in which it takes place, the language employed in that culture and the student's relationships with more capable others?

Neuro-psychologist, Howard Gardner, studied individual intelligence and identified 'multiple intelligences'; in 1999 he defined an intelligence as 'a bio-psychological potential to process information that can be activated in a cultural setting to solve problems or create products that are of use in a culture' (Gardner 1999, pp 33-34). Originally he identified seven intelligences - linguistic, logical-mathematical, musical, spatial/visual, bodily-kinaesthetic, interpersonal and intra-personal; later he added naturalist and toyed with the idea of existential intelligence. I wonder whether there is also 'temporal intelligence', being concerned with the ability to plan and prioritise, to manage one's time, to have a sense of history? Individuals have varying potential in each of these intelligences, he says. The cultural aspects of this theory accord with Vygostsky's work and the 'bio-psychological potential to process information' is an individual's capacity to learn and apply knowledge in different areas, our different 'kinds of minds' (Gardner 2003).

Adult Learning?

It is not yet clear whether adults learn in a way which is similar to or different from the way that children learn yet there is a general feeling that adults tend to have higher motivation (Knowles 1984). Fry, Ketteridge and Marshall (1999), whose focus is undergraduate learning, believe that less mature undergraduates, in age or behaviour, may not be 'adult learners' and that some of the evidence about adult learning is, in any case, 'less than robust' (p 22). Merriam and Caffarella (1999), who write about older adults, cite many writers with differing opinions on adult learning. Some favour

sequential models of development while others suggest that transitions, triggered by life events, may lead to learning. It is self-evident that people do change and develop (whether they are children, adolescents, young adults or older) and inevitably these changes will be reflected in their learning; learning itself involves change.

To quote Tharp and Gallimore again, 'The lifelong learning by any individual is made up of these same regulated, ZPD sequences – from other-assistance to self-assistance – recurring over and over again for the development of new capacities. For every individual, at any point in time, there will be a mix of other-regulation, self-regulation, and automatized processes' (1991, p 54). Barbara Rogoff, working in child development has linked the learning processes occurring in children with those of adults who are novices in a field of endeavour and uses apprenticeship as a model (Rogoff 1990) while Guile and Young (1998), from world of work perspectives, saw apprenticeships as a conceptual basis for 'a social theory of learning'. There may be little difference between adult and childhood learning except the wider experience of adults.

Experiential Learning

The American educational philosopher, John Dewey, argued from a social constructivist standpoint that there is an 'organic connection between education and personal experience' but that the *quality* of the experience determines whether or not educational growth and development occur, referring to some experiences as 'mis-educative' (1938, p 25). The quality of a learning experience depends on the learner's involvement with and the quality of the educational situation. This is an important point and one linked with the way in which the word 'learning' is used in our society, including by MCB undergraduates. In one sense, people 'learn' from any experience but we tend to call it 'learning' only when they 'acquire a knowledge of, gain an understanding of, acquire skill in, become competent in' (Oxford College Thesaurus 1998) something seen as valuable and positive. In terms of placement learning, it can be constructive for a student to learn that a

particular employer or type of work would not suit them. On the other hand, a placement which left a student (who apparently hoped his placement would allow him 'to develop concepts' and 'link biological information') believing that 'Interesting lab work is an oxymoron', might be considered mis-educative (see Chapter 4).

A widely-known proponent of experiential learning is David Kolb (1984), with his cyclical model of four aspects to successful learning. Concrete experience, reflective observation, abstract conceptualisation and active experimentation play their part in Kolb's Learning Cycle; for effective learning all aspects of the cycle should occur. Learners tend to be stronger in some aspects of the learning cycle, weaker in others, and so to have differing learning styles (see forward). Experience does not always lead to learning; reflection is essential (Boud, Cohen and Walker 1993). Concrete experience and active experimentation are 'activity' while reflection and conceptualisation resonate with Vygotsky's internalisation. It is, however, spurious to separate thinking and doing when 'doing at any level of complexity involves thinking, and thinking conducted with any seriousness is a form of action' (Barnett 1994, p 160).

Learners need time to reflect on their experiences from different perspectives and this phase may be strongly influenced by feedback from others. The next stage is one of making sense, internalising and integrating new ideas, and finally employing new theories in planning and problem solving. The learning is tested in new situations and so the learning cycle continues. Perhaps it is better to think of a spiral process, revisiting the same point of the cycle but at a higher level.

Humanists like Carl Rogers and more recently Brockbank and McGill (1998), believe that reflection is facilitated by a teacher-learner relationship. The teacher's role is facilitation of learning and learning involves 'both feeling and cognitive aspects being *in* the learning event … It makes a difference in the behaviour, the attitudes, perhaps even the personality of the learner … Significant learning combines the logical *and* the intuitive, the intellect *and*

the feelings, the concept *and* the experience, the idea *and* the meaning' (original italics). Rogers goes on to say that 'a traditional and conventional approach [to teaching] … almost guarantee[s] that meaningful learning will be at an absolute minimum' (Rogers 1983, pp 20-21). It is Rogers' view that didactic, transmission pedagogy is not conducive to significant, meaningful learning.

Reflection and internal cognitive process may be just one aspect of experiential learning. As implied above, the situation in which learning takes place is a relevant part of the process. Lave and Wenger (1990) recognise that social interaction is a critical component of situated learning, with learners involved in a 'community of practice'.

> 'Communities of practice are groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis … Over time, they develop a unique perspective on their topic as well as a body of common knowledge, practices, and approaches. They also develop personal relationships and established ways of interacting … Communities of practice … were our first knowledge-based social structures, back when we lived in caves.' (Wenger, McDermott and Snyder 2002, pp 4-5).

As beginners/novices move from the periphery of the new community to its centre, they become more active and engaged within the culture until they can assume the role of expert (Lave and Wenger 1999).

Situated learning may be incidental and unintentional and occurs as a product of the learning situation itself. Although situated in a particular context, such learning can, at least in part, be transferred to other situations perceived by the learner as similar since 'in order to function, people must be able to generalize some aspects of knowledge and skills to new situations'

(Rogoff 1984, p 3). Situated learning theory has clear roots in Vygotskian theories.

Donald Schön (1987) believed in the usefulness of experiential learning in professional learning and development (in this case, for architects) and wrote about the dialogic relationship that can develop between student and coach. Learning comes from reflection about a task while doing it. The student's understandings and misunderstandings are revealed by their actions and in dialogue and the coach can respond with further demonstration or explanation. Schön was a keen advocate of professional work experience, believing that much of the learning involved in professional competence was not teachable by conventional means and was best learnt by doing, alongside a coach or supervisor.

There is a clear difference between learning in the natural world (which is situated and contextual) and learning in higher education, which may be abstract and out of context. Fry, Ketteridge and Marshall (1999), writing about higher education, point out the importance of putting theoretical ideas into context and giving them relevance for students by using examples, case studies and practical experiments.

Laboratory and practical work, placements and work-based learning can all result in experiential learning. However, the different phases of the learning cycle must be completed for learning and development to occur. Practical classes may fail to produce desired outcomes if there is insufficient time allowed for cognitive processes. David Jaques points out that 'Laboratory work typically occupies a lot of student time and institutional resources, yet is often a source of incipient boredom to both staff and students' (1991, p 155). He goes on to wonder 'why this should be, in an area replete with openings for discovery learning, scientific purpose and the application of theoretical knowledge' and cites an amusing example of staff-student interaction during a practical class from the work of William Perry who describes a 'brilliant freshman scientist who was so disgusted with "cook book" laboratory exercises that he took to playing variations on themes and finally provoked

his instructor into blurting: “See here, there’ll be no more experimenting in this laboratory”’ (Jaques 1991, p 155).

Work-based Learning

Work-based learning is a subset of experiential learning and many writers, whose interest is organisational/human resource training, have analysed learning within organisations. Many modern writers have moved away from the old, behavioural approach to learning, where learning experiences were defined as those which led to altered behaviour, towards a new constructivist paradigm where learning is seen as a complex internal process in which the learner develops insight and understanding by making sense of situations, problems and experience.

Modern writers recognise the influences on learning outcomes of the social group (the organisation or the immediate work group), and individuals’ perceptions of themselves and their roles within it (Marsick 1987 and Jarvis, Holford and Griffin 1998). Such writers point out that much work-based learning may arise not from planned learning opportunities but informally and incidentally, as a by-product of being in the workplace, doing a job and interacting with colleagues. Seen from this perspective, learning may or may not be identified through measurable changes in behaviour, ‘it may represent a change in an internal viewpoint that is difficult to quantify’ (Marsick and Watkins 1990, p 4). Especially important in incidental learning may be a change of routine, even disorientation, which frees the learner from habitual ways of thinking, encourages critical reflection and so promotes changes in perception.

Griffiths and Guile (1999) write that a ‘neglected aspect is an exploration of how work-based activities can provide the context for “deep” learning’ (p 160). They offer a typology of approaches to work-based learning in the form of five analytical models (pp 168-169). They reject simple models of workplace learning, which are task-, skills- and competence-oriented, and context-dependent, arguing instead for a ‘connective model of pedagogy and

learning' where there is better articulation between formal and informal learning. Experiencing different combinations of theoretical and practical learning, and reflecting on these new experiences, enables students to conceptualise their experiences in different ways and to relate their situated, formal learning to other situations; it enables their knowledge to cross boundaries.

Learning Styles

Many writers have observed, and tried to categorise, differences in people's preferred learning styles (Wolf and Kolb 1984, Pask 1976). Honey and Mumford (1982) identified preferred learning styles that correspond to the four phases of Kolb's learning cycle. 'Pragmatists', they claimed, prefer to learn through concrete experience and the application of theory, 'reflectors' favour reflective observation, 'theorists' learn from abstract conceptualisation and 'activists' learn through active experimentation. The personality of the learner determines which learning styles they favour. Learners tend to prefer one or two methods of assimilating knowledge and successful learners are usually able to switch between styles according to circumstances.

There are strengths and weaknesses associated with each learning style. For example, activists are flexible and open minded, enjoying new situations but have a tendency to act without thinking while reflectors are thoughtful and methodical but may be over cautious and slow to make decisions. Theorists are rational and objective but may dislike uncertainty while pragmatists are practical, down to earth types who may reject ideas which have no obvious practical application. Might placements benefit pragmatists and activists more than reflectors and theorists, or facilitate switching between different learning styles?

In recent years a battery of 'learning styles' and related models have been developed (see Coffield, Moseley, Hall and Ecclestone 2004 for a critical review). Undergraduates are not usually analysed and appraised of their learning styles profiles (although this can be done by questionnaire) so that,

in higher education, the learning styles concept is more about teaching than learning. Effective teaching creates learning opportunities that take account of different learning styles and personal attributes of students and encourages them through the different phases of the learning cycle.

Learning in Higher Education

Most early studies into learning in higher education attributed academic success or failure to the attributes/characteristics of the individual student and concluded that students would perform better if they were told how to study. William Perry is an amusing writer and, in his preface to Entwistle and Ramsden (1983), he tells of writing a manual for freshmen/freshers in 1942 entitled 'Effective Study Methods'. Years later he discovered that his grandfather had written an almost identical manual a hundred years earlier! Perry became interested in the fact that *some* students (but not others) seemed to benefit from these manuals, *i.e.* in the differences between students, and between the same students at different times or in different circumstances. He identified a total of nine stages of intellectual and ethical development (Perry 1970). The major stages can be summarised as follows:

- At the low end of intellectual development students assume that there is a right answer to every question and that the answer is known by those in authority.
- During the middle stage students begin to discover that authorities often disagree and they may adopt the view that every opinion may be equally valid.
- At the highest levels of intellectual development, reached by few, is the belief that truth is relative and depends on context.

A contemporary equivalent of Perry's guide for freshmen is *The Sciences Good Study Guide* (Northedge, Thomas, Lane and Peasgood 1997). It strikes me that recommending study guides to students, in the expectation that their learning will improve, is rather like giving MCB students *Molecular*

Biology of the Cell (Alberts, Bray, Lewis, Raff, Roberts and Watson 2002) and hoping they become good Molecular Biologists!

In Gothenberg. in 1976, Marton and Säljö published an important study, which looked at what students think and do in real situations and reviewed the different approaches that students take to learning. They distinguished between 'deep' and 'surface' approaches to learning. Students employing a surface approach to their learning do not engage with the subject matter but set out merely to complete a task (reading, essay writing, writing up a practical experiment); they do the minimum necessary to get by. They do not gain internal knowledge and understanding and what they learn is quickly forgotten. Those adopting a deep approach to their learning engage with the subject matter in a meaningful way, seeking real understanding from it. They focus on underlying themes and principles. Their knowledge is internalised, becoming integrated with previous concepts, and they are able to recall what they have learnt and apply it in future situations.

It is not possible to categorise the *student* as 'deep', only the student's *approach* to a particular academic task. Entwistle and Ramsden (1983) focussed on the way in which students' approaches to learning are influenced by their perceptions of the environment in which it takes place and added the concept of a 'strategic' approach to studying to the concept of deep and surface approaches. Students who adopt a strategic approach to learning aim to do as well as they can in achieving externally set objectives; they may obtain good results but lack the understanding of those whose approach is deep. Entwistle and Ramsden employed a mix of qualitative and quantitative methods, with a high number of students, to provide convincing evidence that poor teaching, and assessments which students find threatening, increase the likelihood of surface approaches. Biggs and Moore (1993) further examine the way in which approaches to learning can be modified by the context in which teaching and learning take place and are themselves learnt. It seems that academic success or failure are strongly influenced by the quality of the educational environment in which students find themselves.

Ramsden (1992) and others have found that students' perceptions of 'good teaching' consistently correlates with deep approaches to learning. It is tempting and intuitive to assume a causal relationship, in which good teachers generate deep learning approaches in their students and so achieve better academic results but this is slightly problematic. There could be influences in the opposite direction, for instance some teachers adapt their approach to teaching in response to students' requests, for example, requests to go through problems in transmission mode (Trigwell, Prosser and Waterhouse 1999).

Many other studies, using both qualitative and quantitative research methods, have linked teachers' attitudes, their approaches to teaching and teaching quality with students' perceptions, approaches to learning and learning outcomes (Svensson 1977; Biggs 1978; Prosser, Trigwell and Taylor 1994; Marton, Hounsell and Entwistle 1997; Prosser and Trigwell 1999 and Trigwell, Prosser and Waterhouse 1999). In brief, surface approaches are produced when students lack choice about what and how they learn, when they feel overburdened and anxious or when they see assessments as testing their accumulation of facts. When students adopt this approach they feel dissatisfied, have limited understanding, poor retention and lower outcomes. Deep approaches are encouraged by choice and engagement with the subject and result in deeper understanding, better retention and greater academic success. In order to promote the adoption of deep approaches, learning opportunities should be student-centred and designed to help learners engage actively with their subject and to achieve deeper understanding of it.

How can deep approaches to learning be encouraged? Marton and Säljö (1984) conducted an experiment in which they inserted questions into a text which were intended to point students towards adopting a deep approach to reading. The unintended outcome was that students adopted a superficial approach to reading in order to answer these questions! Ramsden, Beswick and Bowden (1986) attempted to train a group of first year students to adopt

more effective learning strategies but this also had the opposite effect, increasing their tendencies to use surface approaches. It may be impossible to instruct students in the use of deep approaches because, as Paul Ramsden says, there is 'an inevitable gap between our intentions and students' perceptions of the context of learning'. He explains that 'we cannot train students to use deep approaches when the educational environment is giving them the message that surface ones are rewarded'. He goes on to say 'It may be helpful to think about the relation between students' perceptions and their approaches at several inter-connected levels. These are the learning task itself (including students' previous experiences of dealing with similar tasks), the quality of interaction with lecturers, the curriculum and assessment and, at the most general level, the atmosphere or 'ethos' of the course, programme of study, or institution' (Ramsden 1992, pp 64-65).

Gibbs (1992) reports a study involving eight college courses as they introduced innovations designed to improve the quality of student learning. He paints a depressing picture of the prevalence of surface approaches to learning and points out that even successful interventions may have only local and short-term beneficial effects. Like Ramsden, Gibbs refers to the importance of course design. Gibbs is a rarity in mentioning placements and states that students generally commented favourably on their learning whilst on placement but points out that a student's deep approach to learning can be dropped as soon as the student returns from placement for the conventionally taught final year.

Good teaching, in a good educational context, is associated with high quality student learning (Trigwell, Prosser and Waterhouse 1999). It discourages surface approaches and encourages active engagement with the subject content. In his theory of constructive alignment, John Biggs (1996; 1999) fused constructivist learning theories with the need to align curriculum objectives, teaching and learning activities and assessment tasks. His conceptual tool or framework for comprehending understanding, which he called SOLO (Structure of Observed Learning Outcomes), was designed to

help academic departments produce integrated courses where the aim is students' gradual attainment of deep levels of understanding and where quality learning is the theme throughout. In order to transform teaching, he says, teachers must collect student feedback and reflect on how they could improve their teaching. Biggs' applies McGregor's (1960) theory Y and theory X to the climate that teachers' beliefs create (in essence, students are trustworthy and keen to learn or they are not) and writes that 'that naturally has positive or negative effects on students'. 'Theory X generates negative feelings … directly encouraging a surface approach' (Biggs 1999, pp 62 and 63 respectively).

Mann (2001) has recently suggested that the concepts of alienation or engagement with learning might be more useful to the study of students' experiences than the focus on deep, strategic or surface approaches. She goes on to say that feelings of alienation in many students, and a consequent diminution in the quality of their learning, may be an inevitable consequence of current HE policies such as widening participation and the current emphasis on efficiency, outcomes and the market economy.

The literature reviewed so far is merely the tip of a huge iceberg; Pascarella and Terenzini (1991), for example, review 2500 studies and their book *How College Affects Students* runs to 1000 pages (in Cross 1998). Yet, with all this accumulated knowledge, improvements have been slow to come. As Cross points out, most academics and administrators do not have time to read 1000 pages and there has been an understandable tendency to reduce the information further into handbooks (*e.g.* Cannon and Newble 2000). In some instances the requirements for good teaching have been condensed even further, to a series of steps or bullet points, presumably in an attempt to make educational theory more accessible to over-stretched academics. For example, Chickering and Gamson (1987) give *Seven Principles of Good Practice in Undergraduate Education* as follows:

- Encourages contacts between students and faculty.
- Develops reciprocity and cooperation among students.

- Uses active learning techniques.
- Gives prompt feedback.
- Emphasises time on task.
- Communicates high expectations.
- Respects diverse talents and ways of learning.

Bullet points like this fail to explain the reasons underlying why good practice involves contacts, reciprocity and so forth. Cross believes that we should use the known principles as a starting point for asking more searching questions. For instance, we know that contacts between students and faculty seem to benefit students but what is it about student-staff interaction which promotes learning? Laboratory practical classes are intended to be active learning opportunities; why is it that many students report learning little from them? Similarly, we know that students often report great benefit from their placements but what is it about placements that result in learning?

Handbooks and lists often stem from the implicit belief, based on a positivist viewpoint that good teaching consists of getting the facts right and developing good presentation skills or wider good practice (Prosser and Trigwell 1999). But the transmission of fact and skills theory of teaching has had very limited success in encouraging high quality undergraduate learning (Ramsden 1992). Improvements in HE may, it seems, require fundamental levels of change in attitudes and beliefs yet individuals and institutions are often resistant to change (Mullins 1993).

Problem-based learning

Although change is slow, some HE professionals are experimenting with innovative approaches to teaching and learning. One such approach, which began in the medical sector, has been the introduction of problem-based learning (PBL). The foremost pioneer of PBL, Howard Barrows, worked with a group in the medical school at McMaster University, Canada, in the late 1960s and ‘70s (Barrows 1996 and 2004). Other medical schools were quick

to recognise the benefits of problem-based learning but it is only in the last few decades that PBL has been widely taken up by other disciplines. The University of Coventry PBL website lists many subject areas using PBL in UK higher education institutions (2004). PBL practitioners in many fields claim that this method directly addresses many of the disadvantages of traditional teaching, which often leaves students bored and, after graduation, with little recall of their studies and lacking the ability to relate theoretical knowledge to solving complex practical problems within their profession.

So what exactly is problem-based learning? It is an approach to teaching which uses realistic, problematic scenarios (the sort of muddles experienced in real life), and subtle questioning by the tutor, to challenge students and, hopefully, instil in them critical ways of thinking, the habit of enquiry and problem-solving abilities which they will be able to transfer to future real world situations. It is, however, not just a method of teaching but also a way of learning how to be a capable professional in the modern world (Engel 1991). The types of problem encountered in PBL actively engage students in their learning and develop in them deeper understanding of information and concepts which they have themselves researched (Boud and Feletti 1996 and Kirk 2000). Many placements generate real professional problems and engage students in finding solutions; the same benefits claimed of PBL could well result from problems encountered in placement environments.

Higher Education in Context

Evans and Abbott (1998) have an excellent first chapter, in their book *Teaching and Learning in Higher Education*, on the recent changes which have dramatically increased student numbers, altered funding arrangements and, by what they call ‘an obsession with quality control measured by external assessors’, encouraged ‘adoption of a more explicit market ethos [which] has come to dominate working conditions, academic activities and the very character of higher education’ (p 7). They go on to quote Johnson (1994, p 379) who states that ‘it no longer matters how well an academic teaches and whether or not he or she sometimes inspires their pupils; it is far

more important that they have produced plans of their courses, bibliographies, outlines of this, that or the other, in short all the paraphernalia of futile bureaucratisation, required for assessors' (p 13).

According to Ramsden (1992) the recent changes 'taken together, mean that the average university … teacher is now expected to be an excellent teacher: a man or woman who can expertly redesign courses and methods of teaching to suit different groups of students, deal with large mixed-ability classes, and juggle new administrative demands, while at the same time carrying a heavy research responsibility and showing accountability to a variety of masters as both a teacher and a scholar' (p 2). Earlier Entwistle and Ramsden (1983) pointed out that 'in universities time spent in improving teaching may even be indirectly penalized. Research output is the main criterion for promotion; the investment of a similar proportion of one's time in improving teaching receives no reward' (p 216).

In *The Limits of Competence: Knowledge, Higher Education and Society* (1994) Barnett argued that the very idea of Higher Education has changed; academic competence is giving way to increasing use of the rival definition of competence (perhaps politically defined and a result of the preoccupation with measurable outcomes) as merely know-how and skills. Instead of academic competence or operational competence Barnett suggests that 'higher education is for life' (p 77); he believes that higher education should provide students with experiences that encourage (amongst other things) reflection, dialogue, openness, thorough testing of arguments and continuing reappraisal of personal learning (p 185).

Top-up fees will cause further changes in the ethos of universities. This "commodification" is clearly demonstrated in a recent advertisement from the University of Leeds for the post of Marketing Director which refers to universities 'adopting a customer, not merely product, orientation and establishing themselves as a brand in a highly competitive and dynamic market' (Times Higher Education Supplement 9th July 2004, p 31).

Placement Learning

As mentioned above, the QAA (2001) Code of Practice on placements states that intended learning outcomes may include specific skills and competences and more general understanding of the cultural context of an academic discipline. The ASET/NCWE Code refers to work-based learning aimed at complementing academic learning and goes on to say that 'It can be argued that a key role of higher education is to prepare students for life-long learning, that is, for a continuance of learning in the absence of a formal learning environment' and that 'from this perspective, a placement is a crucial halfway house, in which the student is becoming [an] independent learner' (p 6).

Certainly employers value placements. The Financial Times reported a survey of graduate recruiters where 'a structured work experience placement as part of a degree' is given as the most likely of a range of activities to enhance graduate employability (Kelly, 7/8 April 2001, p III). Placement learning is known to include (alongside subject-related knowledge and skills) professional ways of thinking and work-associated skills such as time management, team working, communications and organisational skills. Much of the literature on placements focuses on the employability aspect (e.g. Barthorpe and Hall 2000; Blackwell, Bowes, Harvey, Hesketh and Knight 2001). The MCB pages of the University of Bath's Undergraduate Prospectus 2002 said that 'the experience of working on placement helps you to define your career objectives, and also gives you direct evidence of your capability and record which is useful when you apply for a job' (pp 100-101). Interestingly, it did not mention learning, as such, nor refer to the learning opportunity that placements provide.

But what is the view of the wider academic community? Much of the literature on higher education mentions placements only briefly, if at all. Electronic journal searches produce articles that focus mainly on assessment methods or accreditation (*e.g*. Leslie 1999; Rainsbury, Hodges, Sutherland and Barrow 1998). Teachers in HE recognise the role of placements as

useful vocational learning but perhaps as no more than that. The very word 'vocational' is, in some minds, tainted with the suggestion of being not quite as worthy as other types of learning. Mike Edmunds (1999) says that the full educational potential of the sandwich year can only be realised if it is defined in terms of knowledge, skills and competences. He lists ten learning objectives and refers to a dichotomy between two forms of knowledge. On the one hand, he places traditional, theoretical, discipline based, university controlled knowledge. On the other, practical, problem centred, multidisciplinary knowledge with significant amounts of practitioner control. He goes on to argue for recognition of the placement learning in some way and discusses Licentiateship of the City and Guilds Institute, Qualifications and Curriculum Authority Key Skills, National Vocational Qualifications and Occupational Standards. I would argue that this confirms his merely vocational view of placements and perhaps underestimates their importance, although Edmunds does state that students 'perceive the knowledge gained in the sandwich year to be at least as 'valuable' as that gained in other parts of the degree' (p 104). As Young and Lucas put it, 'The NVQ approach to assessment and pedagogy is most adequate where the focus is on lower skills which can be precisely specified' and 'trying to measure learning outcomes … and the view that learning [is] the acquisition of knowledge or skill … are only partial perspectives on the process of learning itself' (in Mortimore 1999, p 104 and p 107 respectively). As Barnett put it 'the language of skills and outcomes is completely unable to handle the idea of understanding' (1994, p 187).

If the typology of approaches to work-based learning proposed by Griffiths and Guile (1999) is viewed as a hierarchy of learning outcomes, many academics seem to view placements at the lowest levels of the hierarchy, as providing merely the knowledge, skills and competences necessary to perform work-based tasks plus some understanding of workplace culture and conditions.

The Association for Sandwich Education and Training (ASET) has recently reprinted a synthesis study of 17 research projects (Davies 1990) which

states that 'The inclusion of supervised work experience as an integral part of an academic course has many advantages to offer students, and these include the following:

- The students see and use the practical application of principles learned in college or university, and are able to use knowledge gained from their work experience to illuminate and assist their subsequent studies;
- Knowledge is expanded beyond the boundaries set by academic studies, and the students are helped to develop intellectual skills in a real-life situation;
- The manipulative skills involved in scientific and technological operations are enhanced by the additional practice gained;
- Students gain an appreciation of the purposes and organisation of the world of work and of the interactions between economic, social and technological factors which govern it;
- The students are assisted in their understanding of individuals and groups in work situations, and have opportunities to accept real responsibility, all of which assists in personality development with a noticeable increase in maturity, motivation and self-reliance.'

Davies goes on to write of the 'development of abilities which are little seen or tested in conventional academic courses' (pp 127-128) yet even here the major focus is on competences and objectives, and on student assessment.

A consideration of the academic competences (knowing that), although perhaps broader than that of operational competence (knowing how), is still restrictive. As argued so eloquently and philosophically by Ronald Barnett (1994), what is needed is a broader perspective of higher education than either of these competences allows. He advocates one that takes account of the processes of change involved in individual growth and development (becoming a better self) and states that the role of universities is one of turning students into members of 'a learning community, with students being

interactive and participatory, mutually supportive but self-critical' (p 193). I believe that placements may, sometimes, have a role to play in this area.

Learning and Learners' Personal Perspectives

With the widespread acceptance of the constructive nature of learning has come growing recognition of the importance of the learner as a person and of their personal perspectives. As yet, though, neuroscientists have no precise understanding of what is involved in the relationship between emotions, learning and memory, although many studies are under way into the roles of particular brain regions, hormones, neurotransmitters and so on. Why is it that our memories of most days are a blur yet we remember where we were on September 11th 2001 or the day we fell in love? Why is it that primary school children will tell you that they find it difficult to learn when they are 'stressed', easier to learn when they feel confident? Surely emotions play some part in memory and learning. Davies, after many years work with placement students wrote that 'Happiness is important, not just for itself, but because success is the more likely and success brings greater happiness and so on' (Davies 1990, p 37).

Salmon (1989) believes that the personal stance adopted by the learner affects the way in which they construct personal meaning and understanding. Savin-Baden (2000) analysed learner experiences of problem-based learning using a framework of three stances, personal, pedagogical and interactional; these stances relate to learners' attitudes, beliefs or dispositions towards themselves, their learning and their relationships with others. Within each stance she identified a number of domains to describe the positions that students may adopt. Stances and domains are not distinct and static but have blurred edges and students' positions may shift (be reconstructed) over time and in different learning contexts. What part, if any, do emotions and personal perspectives play in placement learning?

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How has this brief literature review informed my thinking? I have learnt that:

- Learning is an innate human ability
- Each individual constructs their own understanding in an ongoing, dynamic, cognitive process
- Engagement in purposeful work may provide the basis for learning
- Assistance from more capable people may help the learning of those less capable
- Their cultural background provides learners with means of communication and with particular ways of thinking and acting
- Experience and reflection are important for internalising and integrating new ideas
- Students' emotions may influence their learning.

Further, it seems that:

- Students may differ in their preferred learning styles and 'intelligences', in their types of mind
- Their approaches to learning may vary and are linked to teachers' attitudes and teaching quality
- The current situation in HE puts academic staff under great pressure and fails to reward time and effort spent on teaching
- Placement learning is often viewed as vocational acquisition of skills and competences.

Placement learning from the student's perspective, and explanation of such learning in theoretical terms, appear to be neglected areas. I want to propose the view that placements may (at least in some cases) play a more significant role than is generally recognised, providing learning which goes beyond the simple acquisition of skills and work experience, and beyond academic competence, to that which enhances undergraduates' personal growth and development as human beings.

If students' experiences suggest that placements can offer learning of significance in developing them as people, then surely it should be possible to offer an explanation in terms of learning theories and epistemology. Perhaps the duration of a placement should be seen as allowing time for completion of the learning cycle; tasks are performed and reflected upon, understanding is internalised and the task repeated with greater knowledge (Kolb 1984). The interactive, one-to-one nature of the relationship between placement student and supervisor should be seen as providing high quality instruction, contributing to the student's progression through zones of proximal development (Vygotsky 1978). Perhaps placement learning should be seen as transformational; certainly it appears to alter students in ways that both they and others can recognise (Mezirow 1991). The experiential and situated nature of placement learning contrasts favourably with learning within university (Lave and Wenger 1990). When there is close articulation or 'connectivity' between formal learning and informal workplace learning, students may be encouraged towards deep approaches to their learning and become better able to transfer their knowledge across boundaries (Griffiths and Guile 1999). Crucially, immersion in the culture of a professional placement can give the student an understanding of the language, ways of thinking and ethics of that profession; it helps the student change from being an outsider towards becoming an expert (Vygotsky 1978; Schön 1987; Lave and Wenger 1990). Finally, might an understanding of work-based placement learning help me towards a different understanding of undergraduates' university-based learning?

In the early stages of this study I found it quite difficult to make sense of the different genres of educational literature and it was not until I was involved in the empirical research that I felt able to make judgements about which writers had particular relevance. For this reason, Chapter 5 revisits some of the literature outlined here, together with additional works which underpinned the analytical framework employed. Before that, Chapter 4 outlines the supplementary studies and Chapter 3 outlines the research methodology and explains why I chose to approach the question of undergraduate learning in a particular way.

CHAPTER 3: THE RESEARCH

This research sought to develop understanding of undergraduate learning at programme level by exploring students' perspectives of their learning experiences at university and on placement. It stemmed from the researcher's experiences as a mature undergraduate and as Placements Officer. Since the personal position of the researcher inevitably impacts on the nature of the research, this will be considered first. Ethical considerations are important and will be considered next before methodological issues.

Personal viewpoint

Some of my values and beliefs will already have become apparent but, since they are likely to impinge on research methodology (Greenbank 2003), I shall try to make some more explicit. My biographical background means that I see undergraduate learning largely from the students' point of view. In addition:

- I incline to McGregor's theory Y (Biggs 1999), believing that students are generally truthful, trustworthy and keen to learn.
- I value learning and believe that students should be provided with the best possible learning opportunities.
- My viewpoint is constructivist; I believe that students' perspectives are important because they, and perhaps only they, can provide valuable insights into their learning.
- I believe that (although there is bound to be some room for improvement) the Molecular and Cellular programmes available at the University of Bath are of generally high quality.
- Having worked in higher education, I am aware of some of the current pressures and constraints that exist in HE and recognise that ideal, individual opportunities are simply not possible in the real world.

It is important, too, that I admit to possible shortcomings in the early stages of this study; it was not theoretically driven. This was the case for two reasons: firstly, I knew almost nothing of learning theory when I embarked and the literature review took place at the same time as initial data collection. Initially neither the literature nor the data made much sense to me. Secondly, I found myself reluctant to adopt particular learning theories until I had compared them with the data. Perhaps my scientific background caused me to seek 'evidence' to support the theory. As a result, questions were asked based largely on intuition and instinct and answers were sought around areas of interest to me at the time. Only later did patterns begin to emerge and ideas to form, as a result of the to and fro between data and literature. These ideas were often rejected or remodelled to reach my current understanding, which is evidence-based and theoretically informed and remains dynamic, subject to change. The evolution in my thinking is demonstrated by the frameworks for analysis given in Appendix 3.

Ethical considerations

All participants volunteered to take part in the project and there was no coercion or pressure put on students at any stage, and no payment. They took part because they wanted to but why? Perhaps some took part, at least initially, because I asked for their help. Some may simply have wanted to voice their opinions. Many students made a major commitment, in terms of time and effort (even when busy and feeling pressurised) and I believe they did so in the hope of improving the learning experiences of future undergraduates.

In avoiding any detrimental effect on participants, the most obvious ethical consideration is one of anonymity; nothing the students told me should be identifiable as coming from them individually, nor should it influence their relationship with their Department in any way. Care has been taken over anonymity but where there was a single mature student in a cohort, or a single student on placement in Europe, the possibility remains that individuals could be identified. Thesis publication after all participants had

graduated ensured their anonymity until after graduation, when the vast majority left the University.

Ethics are a matter of personal judgement in particular situations and there were instances where I had to exercise mine. One example was that of a student who had been involved in a road accident and suffered some after effects while abroad; in this case I decided that his academic tutor should be informed. Another situation involved one student telling me that he was 'concerned' at the extremely long hours being worked by a fellow student ('usually around 15 hours a day') and asking for my advice. I suggested the student should discuss his working hours with his supervisor, if he felt able to, or with the Department of Biology & Biochemistry, and kept in regular contact with both students until the situation improved.

One participant took a year off, suffering from clinical depression. Should I avoid seeking her views for fear of adding to her burden? Would she feel excluded from the exchanges I was having with her peers? I decided to email, saying *'Would you like to contribute again? There is, of course, no pressure for you to do so (and I fully understand if you are too busy) but it would be great to hear your views'*. I did not expect a reply but received two pages of email describing 'How it has been for me'. At the end of the year she wrote 'Thank you for your support over the years. I think our general consensus is that you were the only person in the department who would actually listen to our opinions and take note. It really has meant a lot' (L2, June 2005). Linked to this ethical matter is the question of bias - would my data be biased if I excluded this participant because of her depression or skewed in a negative direction if she was included? In fact, her opinions were in line with those of others in many respects.

Although care was taken not to disadvantage students in any way through their participation in this research, it was not my expectation that some participants would benefit from their involvement in it. I was therefore surprised when a number of them, in addition to L2 above, thanked me for

the opportunity to express their thoughts and feelings, saying that it had helped them (there are further examples in Chapter 6).

THE RESEARCH

This section describes the research, its design and methodology, and goes on to consider 'reliability' and 'validity'.

In order to understand students' perspectives of their degree programmes, the major focus of data collection was a longitudinal study which tracked one cohort of undergraduates from university entrance to graduation three or four years later (Chapter 6). Supplementary data from three other cohorts provided additional information (Chapter 4). Since the placement component of an undergraduate degree programme was seen as able to provide the opportunity for learning that was somehow 'special', the initial focus of attention was on students' experiences while on placement. It seemed extraordinary and significant that, despite the huge number of variables (the nature of the student and of the supervisor, their relationship, the type of work undertaken, the local conditions and so on), placements were frequently viewed by all stakeholders as beneficial learning experiences.

One motivation behind this research was a desire to understand why and how placements promoted undergraduate learning. Insights derived from the study into placement learning were then used to inform the wider study into university-based learning experiences.

Research Design

Aims

The aims of this research project were to understand students' experiences of their undergraduate learning opportunities, including placements, and to identify ways in which their learning came about. This relates more to the processes involved in learning than to the specifics of what is learnt.

The research questions are based in the following areas:

- What is the nature and quality of placement learning? Is it merely the acquisition of skills or might it also involve students in a deeper understanding of their chosen subject and themselves?
- What is involved in the process of learning from placement experiences? How does it come about?
- Which elements of placement situations promote such learning or sometimes inhibit it?
- How does placement learning compare with learning from other, university-based, aspects of the MCB programmes?
- Why might students (or some students) learn more, or differently, from some learning situations than from others?

The important questions were Why? and How? In order to answer such questions, the research had to be more than a survey of students' opinions, it had to include theoretical analysis (see forward).

In addition to providing greater generic understanding of undergraduate learning, the project had the secondary aim of pointing out areas with potential for quality enhancement at programme level.

Approach

The theoretical approach underlying this research was socio-cultural constructivism (Vygotsky 1978); the belief that students construct their own realities through processes of internal change, in a manner which is influenced by their social interactions and wider cultural environment.

The scientific methodology familiar from research into Molecular and Cellular Biology (where experiments are arranged such that all variables but one are held constant and appropriate controls set up, and where preconceived

theories are tested) seemed totally inappropriate for this research project. Instead this project was naturalistic and inductive, intended to discover something about undergraduate learning by enquiring into students' lives in their everyday settings, at University and on placement.

The project was qualitative, making use of graduates' and undergraduates' descriptions of their learning experiences. The research did not seek for a specific hypothesis to account for placement learning, in all its manifestations, but to describe the nature of such learning and to relate its promoters and inhibitors to wider learning theories and to university-based learning. Why qualitative? Because the intention was to understand the nature of undergraduate learning, and the how and why, rather more than what (in terms of Molecular and Cellular Biology) was learned, although this is, of course, fundamentally important.

During the course of this project, the University and its Students' Union produced their Student Satisfaction Survey 2003 (McGall, Williamson and Aggleton 2004); this was largely quantitative and did not yield information on students' experiences at programme level. This coincided with the QAA Institutional Audit recommending that the University of Bath should 'Consider how to undertake the systematic collection of information at programme level to support the ability of the University to have a good overview of students' experience' (QAA 2003, p 1) and was followed by a publication from the Learning and Teaching Support Network (LTSN. Brennan and Williams 2004) which states that qualitative and open-ended questioning 'can help explain *why* something is going well or not so well' (p 17, original italics). Qualitative research seemed more appropriate than quantitative for addressing the types of questions tackled here. Numbers are, however, sometimes of interest and have been included when it seemed appropriate; for example, the Student Satisfaction Survey 2003 had an overall response rate across departments of 11.5%, and a response rate of 15.3% from students in the Biology & Biochemistry Department, whereas this research achieved very high response rates of up to 88%.

Strauss and Corbin give personal preference as one of the valid reasons for doing qualitative research and another (more valid) reason of its match with the research question; seeking to gain novel understanding of undergraduate learning is one such, which 'lends itself to getting out into the field and finding out what people are thinking and doing' (Strauss and Corbin 1998, p 11).

One major premise behind the methodology was the belief that understanding of individual and social experiences can come from studying people. The most direct way to discover students' perceptions of their learning experiences is to ask them. As Patricia Cross put it, 'if you want to know how students learn, find out what makes them tick' (Cross 1998, p 7). Paul Ramsden states that students are a reliable source of information; writing about research into teaching he wrote 'The research findings … mirror with singular accuracy what your students will say if they are asked to describe what a good teacher does. College and university students are extremely astute commentators on teaching. They have seen a great deal of it by the time they enter higher education. And, as non-experts in the subject they are being taught, they are uniquely qualified to judge whether the instruction they are receiving is useful for learning it. Moreover, they understand and can articulate clearly what is and what is not useful for helping them to learn' (Ramsden 1992, p 89). This project was based on the premise that MCB students could describe their learning in such a way as to help identify the nature of their learning, the processes by which it came about and those factors that helped or hindered their learning.

The research is phenomenological, being concerned with the manner in which students perceive their learning experiences. Phenomenology is concerned with understanding social phenomena from the actor's own perspective. The important reality is what people perceive it to be (Taylor and Bogdan 1984). This type of phenomenological research is also called phenomenography, defined by Trigwell as 'the empirical study of the limited number of qualitatively different ways in which we experience, conceptualise, understand, perceive, apprehend etc, various phenomena in and aspects of

the world around us.' He goes on to say that 'These differing experiences, understandings etc are characterised (by the researcher) in terms of categories of description, logically related to each other, and forming hierarchies in relation to given criteria' (Trigwell 2003, p 3). The role of the researcher is, therefore, one of identifying variation, grouping different phenomena into categories and looking for relationships. It is also one of interpretation; the interpretive tradition goes back to Max Weber (1864-1920), one of the founders of sociology, who believed that it is possible to understand something about other people from an empathy with them. Data are conveyed through descriptive narrative which incorporates quotations from research participants, and analysis is based on grounded theory because 'theory derived from data is more likely to resemble the "reality"' (Strauss and Corbin 1998, p 13, but see forward).

Methodological choices were sometimes pragmatic, dictated by practical considerations such as access to participants, and sometimes informed by the literature on research methodology. Some literature is specifically referenced but additional background reading included Bryman 2001, Denzin and Lincoln 2000, and Sarantakos 1998.

Participant selection

The major part of the research involved one cohort of undergraduates from their entry to university to graduation. Data were gathered from these participants at regular intervals throughout their time as undergraduates, both at university and on placement (Chapter 6). In addition, supplementary data were gathered from one cohort of graduates and two further cohorts of undergraduates of Molecular and Cellular Biology at the University of Bath. The number of volunteers was rather more than anticipated; a very high proportion of those invited to take part volunteered to do so and there were a total of 70 participants. Together they provided information on experiences spanning over a decade, from the intake of 1994 to the cohort who graduated in 2005. MCB students were chosen, over other categories, because I had been an MCB student and hoped for empathy and understanding between us on that

account. Empathy with participants helps the researcher to see things from the participants' point of view, to enter into their life-world (Ashworth and Lucas 2000), while understanding comes from shared meanings within a common speech genre (Bakhtin 1986). Students from courses other than MCB were not included because the degree of shared understanding would most likely have been less while the volume of data would perhaps be more than one person could readily analyse.

The concept of shared understanding is an important one. In one sense it is never possible to know what other people understand as it is constructed internally and individually. On the other hand we do share some common meanings in the words we use, particularly when we have had similar experiences, and can come to similar understandings; we could not function as social beings if it were otherwise. In the case of this project, researcher and researched shared the experience of being students of MCB at Bath, had studied the same subjects in lectures, practical classes and seminars, been taught by the same teachers and had a shared vocabulary. The researcher had undertaken placements in UK and US and visited over a dozen varied placement institutions in England, talking to students and supervisors about their work. In addition, she had varied experience of laboratory work covering many of the same techniques and procedures used by participants, and was familiar with their text books, websites, reference material and so on. It is reasonable to assume that there was some shared understanding between us.

Several groups of participants were chosen for different elements of the research process. Groups G, IR and DP were used in studies which supplemented the major study by assisting towards progressive focussing of research categories and testing of the research instruments (Chapter 4). Work on data from these three groups resulted in a conceptual model of placement learning and a research-based framework for the analysis of placement learning (Chapter 5) to be tested in analysis of the main, longitudinal study with Group L (Chapter 7).

Of the 70 students in this study, there were 24 male students and 46 females; MCB does attract more females than males but there may also have been a slight tendency for the female students to be more responsive to requests for data. The vast majority of participants were young, white, British and from (in common parlance) 'middle class' backgrounds, who came to the University of Bath with A-levels acquired at school. Minority groups, e.g. mature, foreign, working class or 'access' students, were in insufficient numbers for their data to be significant.

The following table shows participant student groups, research objectives and data collected.

Table of participant student groups and data sets

Group	Group characteristics	Research objectives	Data collected
L.	Twenty-six students took part in a longitudinal study, 2001-2005 (L1-26), some all the way through, some occasionally. There were 11 males and 15 females including one mature woman. Seven followed the Masters programme. 16 contributed placement data, 8 UK-based, 1 in Europe and 7 US-based.	To obtain data over the 3- and 4-year degree period. To obtain data on individual students over time. To complete data collection. To complete the process of categorisation.	Group and individual interview tapes and transcriptions. Email responses to questionnaires (Appendix 2.3 & 2.4) and open enquiries plus general email dialogue. Notes from informal meetings.
G.	Eleven graduates from the 1994 intake who graduated in 1997 and 1998 (G1-11). 4 males, 7 females. 10 undertook placements, 1 did not. All placements were UK-based.	To obtain a quick, retrospective overview of the MCB course from those who had had time to reflect on their experiences. To help focus the enquiry. To pilot the use of questionnaires.	Responses to an email questionnaire (Appendix 2.1).
IR.	Seventeen undergraduates newly returned from placements, 2002 (IR1-17). 4 males, 13 females. 7 on the Masters programme, 10 studying for BSc. 10 UK-based placements, 5 in the USA and 2 in Europe.	To obtain an immediately retrospective view of placement experiences. To pilot open questioning. To continue the process of idea focussing.	Responses to general enquiries and a questionnaire, by email (Appendix 2.2).
DP.	Sixteen undergraduates during their placements, 2003 (DP1-16). 5 males, 11 females including 1 mature woman. 11 on the Masters course, 5 studying for BSc. 9 UK-based placements, 6 US and 1 Canada.	To obtain contemporaneous descriptions of placement experiences. To continue the process of focussing and category finding.	Responses to general, unstructured requests for information, by email. Notes from some individual meetings.

Although nearly all the data came from students, some additional data derived from contact with three members of the Department's academic staff, who provided their views of learning to teach at the University of Bath.

Data collection

Since, for practical reasons, the study could not include direct observation of each student during their university- and placement-based experiences, it had to be conducted solely through conversations and written texts about those experiences.

The longitudinal study involved the collection of data from one cohort of students at regular intervals throughout their time as undergraduates, including three years at university and, for most, a year on placement (Chapter 4). The setting for the research was not contrived but natural; meetings occurred on campus and emails were exchanged in the normal way. Although initial studies employed questionnaires and structured interviews (which seemed appropriate in the beginning) this later felt as if the researcher was dictating the agenda. Subsequent interactions were less structured, allowing participants to reveal what was significant to them through natural dialogue. This accords with the category "what a student notices" used by Sinclair (2005). First and second year meetings were focus groups, attended by several students. Final year meetings were more varied, sometimes involving a group or a pair of students but also one-to-one meetings with individual undergraduates.

The vast majority of data took the form of tape-recorded interviews and transcriptions (carried out, by the researcher, as soon as possible after interviews and validated by participants), printed email questionnaires and informal email communications, and field notes made immediately after informal meetings. On the subject of these notes, three examples of students' responses to them were as follows:

- 'I thought your write up of our discussion was good. Are you sure you weren't taping us?!' (L1, July 2004).

- ‘What you wrote was accurate and I have no changes to suggest’ (L19, October 2004).
- And, after minor amendments and additions, ‘I think it provides a fair picture of my placement experiences’ (L20, October 2004).

Group interviews involved a varying population of students, depending on who could spare the time from studies, tutorials etc (and who had the inclination to attend!). A table of participation in the longitudinal study is given in Chapter 6.

Since the research questions concern the nature of undergraduate learning and how it comes about, the types of question posed in this research are more to do with the learning process, the *how* of learning, than with what is learnt, although it is not always possible to separate the two. In a scientific degree, learning involves the acquisition of theoretical knowledge, practical skills and, hopefully, powers of critical reasoning. The range of this research is, however, somewhat broader than this as it also encompasses life skills and personal growth/development. Therefore, when students were asked about their perceptions of learning experiences, the questions posed were sometimes similar to those used by Ramsden, in his Course Experience Questionnaire (1992, appendix) but, as the project progressed, questions became more open and wide-ranging. Questions were an important tool and the usefulness of question types was monitored and adjusted as the research progressed.

The supplementary studies involved 1998 graduates (Group G) and placement students (Groups IR and DP), who provided data by email in response to questionnaires or more open questioning (Appendix 2). Data from staff were collected through conversations and email. Later in the study, another type of data was used in analysis of longitudinal data; this took the form of published sources of information about the Department and the University which were downloaded from their web pages (see Chapter 7).

The following table outlines the data collection process:

Table outlining the research and data collection process

Throughout the project there were continuous or, more correctly, iterative processes of data collection and analysis, reading and rereading of the literature, testing and refining of the research instruments, more data collection, further reading etc.

Longitudinal study			
Year 1	**Year 2**	**Year 3**	**Year 4**
• Project explained to new undergraduates and their cooperation sought. • Data collection at the beginning, middle and end of their first academic year.	• Second year data were collected at the end of first and second semesters. • Rapport developed.	• Ongoing data collection and analysis from those on placement - a busy period. • Contacts with non-placement final year students. • 'Reality checks' asking participants to compare tentative findings with their own lived experiences. • Ongoing writing and re-writing.	• Contacts with post-placement students throughout their final year. • Data collection from web pages. • Validation, refinement and final analyses. • Completion and submission of thesis.
Supplementary studies			
• First draft of research questions. • Questionnaire design. • Data were collected from Group G. • Initial analysis began. • The project began to focus. • Background reading. • Initial draft Chapter 1.	• Data were collected from Group IR. • Draft literature review. • Questioning shifted from specific to general/open. • The research questions were finalised. • Data were collected from Group DP. • Draft frameworks for analysis evolved.	• Meetings with some Group DP students after placements. • Draft methodology chapter. • Preliminary data and findings written up. • Conceptualising, theorising, modelling and emergence of new analytical framework. Draft of Chapter 5.	• Collection of data from academic staff. • Collection of data from published sources.

Data Analysis

Analysis in grounded theory research has been described as both a science, in maintaining rigour and grounding analysis in the data, and a creative art. Creativity is involved in deriving apt name categories, asking stimulating questions, making comparisons and the ability to arrive at 'an innovative, integrated, realistic scheme from masses of unorganised raw data' which 'offers an explanation' about a phenomenon (Strauss and Corbin 1998, pp 13 and 22 respectively). Since researchers can never be entirely free of preconceived ideas, the scientific rigour comes from the researcher setting aside or 'bracketing' their own assumptions, as far as possible (Ashworth and Lucas 2000). For example, I had to set aside my initial belief, that almost all placements were valuable learning opportunities for almost all students, in order to learn that some result in very little learning and that occasionally students had a really bad time.

Data were analysed line by line and words, phrases or longer fragments carrying meaning were selected, often using word-processed cut-and-paste (see Stewart and Shamdasani 1990 and Vaughn, Schumm and Sinagub 1996). Microsoft Word was selected because it had sufficient facilities and functions (e.g. Edit, Find) to carry out the analytical tasks required in this research (Coffey and Atkinson 1996) and because it was readily available without the 'difficulties and frustration [involved] in learning and using' qualitative data analysis software (Fielding and Lee 1998). When I explored the software package, NVIVO, I felt there might be a danger of over-complicating the analysis. In addition, I believe that coding categories remained fluid in my mind for longer, using Word, than might have been the case with specialist software. Simple content analysis was used for the most part but sign-vehicles (signs other than words that also carry meaning, e.g. a student's blush, a collective titter, an email smiley face ☺) have been included where relevant.

Analysis was largely inductive, with theories emerging from the data and empirically-derived theories being compared with those from learning

literature (see Chapter 5). Analysis involved identification of similarities and differences in reported experience, looking for themes or patterns (open coding) and connections/relationships (axial coding) within the data; these provided categories under which different data were collected, arranged and compared. As Hedges put it, 'the real data processing goes on inside your own skull' (Hedges 1985, p 88); when it occurs at night it can feel like 'The Nightmare Song' from *Iolanthe*! (Gilbert and Sullivan 2005).

As a starting point, the first data set was grouped simply into positive and negative perceptions of university experiences, including placements. The second was analysed for what was learnt on placement, including MCB- and work-related skills. Later analysis examined the nature of student learning and the learning process. A later stage examined the links between some analytical categories and pointed to factors which may contribute to placement learning or inhibit it.

It took many months of searching through the data and going back to the literature before a satisfactory framework for analysis began to evolve. The themes emerged from working with the data, i.e. from the students' descriptions, but some category names came from the literature. Eventually, the emergence of a conceptual model led to the framework for analysis, based on socio-cultural and activity theory (Chapter 5), which was tested with data from the longitudinal study. Draft versions of the framework are given in Appendix 3 to demonstrate how ongoing research caused an evolution in thinking about analytical categories and their relationships.

The final stage of analysis used the model and revised framework, derived from research into placement learning, as the basis for interpreting undergraduate learning from university-based learning opportunities. However, in order to account for disparity which sometimes occurred between intended learning outcomes and those reported by students, theories of action had to be considered alongside socio-cultural and activity theories; the final framework involved a fusion between the two theoretical approaches (see Chapter 7).

Presentation of data

In some cases data are displayed in table form, with each row representing one student's input. Others are presented in the form of individual student profiles. However, the method of reporting the majority of data uses a narrative style with quotations. Within normal text, each pair of quotation marks (‘ ’) contains the words of a single respondent. Where quotations are bulleted, each bullet point indicates quotations from a single student unless otherwise stated. Three dots (…) within quotations indicate omissions, square brackets [ ] enclose words added by the author and [?] indicate words unclear on audio tape or whose meaning is unclear in email text. Some spellings have been corrected, e.g. definately is replaced with definitely, but otherwise the text comes from the respondents and the use of CAPITALS or punctuation (!!) is their own. Quotations are referenced individually; letters refer to groups of participants and numbers to individuals within the group, e.g. G1 = graduate No. 1, L2 = longitudinal study group, student No. 2.

Data are presented separately from any interpretation, to enable the reader to draw his or her own conclusions about what the words mean before considering the analysis and conclusions drawn later.

Reliability and validity

Guba suggests that research of this nature, carried out in natural settings, does not fit with words like ‘reliability’ and ‘validity’ and sees them as relics of the old scientific paradigm, where reality was unproblematic and discoverable (Lincoln and Guba 1985). This research is intended, most of all, to be a rounded representation of the views of MCB students and a theoretically-informed interpretation of their experiences based on my understanding, enriched both by having been an MCB- and placement student myself and by reading about learning. The research was student-centred and evidence-based.

Of the research approach:

This type of qualitative research, where data is gathered through interactions with participants, has been criticised because studies cannot be precisely replicated (the same participants would respond to another researcher in a different way, different students would respond to the same researcher in another way and responses would be different at different times); reliability is therefore problematic and findings from one study may have only limited applicability in a wider forum. It may be that students at other universities or studying in other areas have totally different experiences and the only real way to determine this would be through further research. As with ethnographic research, internal validity depends on 'rigorousness and the specific concern of the [researcher]. When that entails analytic induction and reflexivity the internal validity of the theoretical conclusions may well be very high in comparison to many of the deductive approaches', where the danger exists that relevant information can be missed or ignored (Gill and Johnson 1991, p 125).

My personal involvement with the graduates and students, which can be seen as one of the strengths of this research project in terms of providing an empathetic understanding of their language and experience, can also of course be seen as a serious drawback with the potential to introduce bias. With this in mind, the approach I have tried to adopt is one of maintaining a balance between objectivity and sensitivity (Strauss and Corbin 1998). Peter Reason refers to critical subjectivity and defines it as 'a quality of awareness in which we do not suppress our primary subjective experience; nor do we allow ourselves to be overwhelmed and swept along by it; rather we raise it to consciousness and use it as part of the enquiry process' (Reason 1988, p 12). It was the words of the participants that were used to inform this research and reflection on those words that enabled me to focus in, progressively, on what was significant about undergraduate learning. The findings are derived from other students' experiences, not mine. It is inevitable that my own undergraduate experiences have influenced my thinking; my reflection on them sparked and informed this research. I am,

however, acutely aware that student's experiences are varied and have attempted to avoid bias by putting my own impressions aside and including a wide range of disparate perspectives gleaned from 70 other students.

The graduates (Group G) knew me as a fellow graduate (albeit a mature one) and, in some cases, as a friend. The undergraduates knew me as their Placements Officer and/or a postgraduate student, Research Officer and/or friend. My approach to these students was consciously informal and encouraging in an attempt to minimise the age, status and power differences that existed between us and so encourage them to speak naturally and frankly. An email exchange provides an example of the informal relationship which developed between researcher and research participant:

> Researcher's email included '*Any chance of buying you a beer sometime soon? It would be great to catch up on what you've been doing and what you reckon to final year so far*'. Student's response included 'I can't say no to that! Wednesday is good' (L3, February 2005).

This informality might seem unprofessional to some but I believed (increasingly as the project progressed) that it was an effective way to build rapport. In addition, I tried to be accepting of everything I was told. One student (L1) described my approach as 'uncritical'; I hope she meant non-judgemental!

My involvement can be illustrated by interview situations. I have been what Holstein and Gubrium (1995) call an active interviewer, in that I aimed to cultivate rapport between myself and the participants and was happy to interject with pertinent personal stories occasionally, although usually in response to a matter raised by the students in the first instance and often intended to reassure them on some point of concern (e.g. I told stressed students that I always took one day a week off studying, even in final year). That said, however, I agree with Miller and Glassner when they say that 'we are not willing to discount entirely the possibility of learning about the social world beyond the interview in our analyses of interviewing data.' They go on

to point out that 'In our experience, interviewees will tell us, if given a chance, which of our interests and formulations make sense and non-sense to them.' (in Silverman 1997, pp 99 and 103 respectively). The relationship between researcher and participants has been a two-way process, a dialogue, and especially so with Group L. Participants were frequently encouraged to say which of my ideas did or did not make sense to them. The model and analytical categories evolved through discussion with them and the resulting interpretation accords with students' own views of their learning.

Of data generation:

Restricting the project to students of Molecular and Cellular Biology results in it being relatively small-scale and open to criticism on that account. The scale of the project did, however, make it manageable and an individual researcher might not have been able to cope with additional data. Groups of MCB students were selected for different purposes, including contemporaneous and retrospective views.

In one sense the students were self-selected - they volunteered. Were they perhaps the more motivated, capable, self-confident or articulate students? The high rate of participation (as high as 88%) gives some confidence that the data are indeed representative and, incidentally, compares very favourably with the Student Satisfaction Survey 2003 carried out by the University and its Students' Union, in which the overall response rate was 11.5% and that from students of Biology & Biochemistry was 15.3% (McGall, Williamson and Aggleton 2004).

The major advantage of a longitudinal study was the opportunity it afforded to study changes in students' perceptions over time and to explore aspects of their learning while they were studying for their degrees (i.e. during the process of change and learning while they were experiencing them). In addition, it enabled profiles of individual student's experiences to be built up, giving a slightly different dimension to the research data. The four year relationship with this group allowed a prolonged dialogue with them and

increased my understanding of their perspectives. The value of using different participation groups/data sets lies not simply in their different perspectives but also in the opportunity this presented for testing research instruments.

The advantage of retrospective studies is that students, especially the graduate group, had had some considerable time to reflect on their experiences and on how their placements had contributed to their degree programme as a whole. They also knew, from postgraduate, postdoctoral and work experience, how valuable (or otherwise) their undergraduate studies had been to them since leaving university. Of course, retrospective studies can only be a reflection of respondents' *memories* and may not represent their experiences at the time; there is the potential for some loss of accuracy. In fact they told a very similar story to that of current students. In addition, graduates giving individual email responses some long time after graduation, do have the advantage of detachment from their old Department, and from each other; they are free of constraints and pressures that could otherwise influence them. For example, there was an admission to concocting results in practical classes, which is something current undergraduates might be unwilling to disclose.

'Snapshot' studies with Groups IR (retrospective) and DP (contemporaneous, during placement) were a speedy way of generating useful data to inform the main, longitudinal study.

In addition to multiple groups of participants, multiple methods of data collection (group interviews, individual face to face meetings, emails, questionnaires and open dialogue) were used in order to gain a deeper understanding of students' experiences than would be possible from a single method; it is a form of triangulation (for those who like such words), of cross-checking for trustworthiness in the data (Burgess 1984).

Some independent triangulation was provided by researchers studying teaching and learning environments in the Biology & Biochemistry

Department at Bath who found evidence of placement learning; placements 'seemed in some cases to have had a marked impact on [students'] engagement with their studies and on their understanding of how research evidence might be derived, interpreted and reported' (McCune 2003, p 21) and whose data on tutorials, assessment and feedback accord with mine (Hounsell and Litjens 2005). In addition, a member of Biology & Biochemistry's academic staff found students' views on the use of 'chalk and talk' and PowerPoint in lectures to be the same as those which participants expressed to me (see Chapter 6).

Participants in group interviews inevitably influence each other's responses, but they may collectively generate significant issues. It is interesting to debate whether interview responses give direct access to students' experiences or whether they are actively constructed as part of the interview process (Silverman 2001, p 113). Certainly an interview is an active, rather than a passive, process. As Holstein and Gubrium (1995) put it 'All interviews are interactional events … they are constructed *in situ*, a product of the talk between interview participants' (p 2).

The use of email, on the other hand, allows individuals to express their views without external influence. Students' informal use of email is spontaneous and similar to their speech, much less formal than traditional letter-writing (internet communication is known as 'chat' and respondents commonly ended their emails with 'talk to you soon'). One major advantage of email lies in its ability to overcome the disadvantages of time differences between countries; this was relevant where students were on placement in America. Another advantage is that printed emails capture student words without the need for field notes or transcription. Bryman (2001) writes of the growing interest in emails and the realization of its 'considerable potential' as a research tool (p 371). As suggested, each method of data generation/data collection, whether group or individual, face-to-face or at a distance has inherent advantages and disadvantages (see Mann and Stewart 2000) but the use of a range of methods, over a prolonged period, is likely to minimise potential shortcomings.

The major strategy for data generation was questioning. A lot of thought went into this aspect of the research and adjustments were made in the nature of questioning. The project began with questionnaires (e.g. Ramsden 1992, appendix) but this was later seen as generating answers to preconceived theories rather than allowing the data to lead the enquiry. The move towards less structured questioning and dialogue allowed participants' own agendas to inform data collection. Questions which did not 'work' as expected (e.g. Do you think you are learning in depth or learning many things more superficially? Answer: 'A bit of both really'.) were abandoned in favour of those which did yield useful data, e.g. 'How's it going, this semester' or 'How did you find practicals?'

Of the data:

Use of multiple types of data increases their likely reliability and validity. The use of tapes, transcripts and email texts has the great advantage that their existence is reliable evidence of the words and phrases used by students, which can be referred to again and again. Where uncertainty or ambiguity existed, clarification was sought. For example, when a supervisor was described as a 'cool' guy to work for, I asked whether this was meant in the American sense or whether he was perhaps distant. Notes of informal meetings were written up as soon afterwards as possible and sent to participants for amendment or verification. In addition, during the selection process each quotation was considered in its context and, if it arose as a result of a leading question rather than spontaneously, it was examined with particular care and usually discarded.

As stated above, data are presented separately from any interpretation, to enable the reader to draw his or her own conclusions about what the words mean before considering the analysis and conclusions drawn later. Much of the text is in narrative form. This 'storytelling' is intended to allow 'the liveliness, the involvement and even the passion', as well as 'the meaning of [students'] experience to become manifest' (Reason and Hawkins 1988, pp

79 and 80 respectively). In producing a narrative, the source material has to be used selectively, of course, but everything between quotation marks can be supported by hard evidence and has been chosen for the contribution it can make towards a truthful representation of the broad range of experiences of all the research participants. That said, though; the research findings are inevitably the personal interpretation of one person but one who aimed to be critically subjective (Reason 1988).

Of analysis:

Data analysis was a highly iterative process of referring back to the literature in order to compare evolving ideas with published theoretical accounts of learning. This facilitated understanding of the context of these tentative findings, within accepted theory, and identified areas in which current literature seemed to be incomplete. This process helped to frame the questions to be considered in each new phase of enquiry.

Any learning situation is complex and students' experiences of their degree course and their placements can, of course, be analysed in a number of ways. In order to gain a rounded picture of the nature of MCB learning, analysis has to take account of the many types of learning that can result, including laboratory and MCB-related learning, work-related learning, academic and professional learning (ways of knowing, thinking and acting) but also of the incidental learning which can, in some cases, alter students' views of themselves and their role in, and relationship with, the rest of the world. Such learning, when it takes place, can have significant, sometimes transformational, effects on learners' future lives. Since learning of some sort is an inevitable consequence of any experience, but some experiences can be mis-educative, it is important to examine not merely *what* is learnt but the *nature and quality* of the learning experience (Dewey 1938).

The use of grounded theory, allowing analytical categories and their relationships to be dictated by the data, is arguably the best guardian of credibility and validity; the understanding derived may be incomplete and

may not be the only possible interpretation of a situation but, almost by definition, it has to be one of them. Grounded theory has been criticized on the grounds that, undoubtedly, no researcher can ever be truly theory-free. Certainly I began with the idea that most placements were good opportunities for learning but was able to bracket this view. Another assumption was that participants would be able to articulate their learning experiences in a way that the researcher, who had some similar experience (and therefore some shared meaning) with them, would be able to interpret and make some sense of; readers must judge this for themselves. Coming to educational theory from another field (Molecular Biology) was helpful in the sense that I was not over-burdened with educational pre-conceptions when I approached the study, but a more acceptable description of the analytical basis for this research might be 'grounded theory *as far as is possible'*.

Finally, as mentioned before, the longitudinal study afforded opportunities to run the ultimate 'reality check', that of asking participants whether or not the emerging ideas (models, frameworks and findings) matched with their own experiences. In other words, students were able to say whether the emerging ideas and tentative answers to the research questions accorded with their own views (e.g. L9, L11 and L12, November 2004).

* * * * * * * * * *

The preceding chapters have explained the background to the research project, described the methodology underlying it and the methods employed, and placed the research questions into context. The next chapter begins to engage with the research questions through data and findings from the supplementary studies with Groups G, IR and DP. What these additional studies revealed, in terms of developing my understanding of undergraduate learning prior to analysis of the longitudinal study, is considered in Chapter 5.

CHAPTER 4: SUPPLEMENTARY STUDIES

This chapter will outline firstly the data and then the findings from work with each of three groups of participants who took part in studies which were additional to the major, longitudinal study. The following chapter is a reflection on these studies, in the light of learning theories from the literature, and explains how the understanding derived from them helped to inform research with the main, longitudinal study group.

The supplementary studies had limited objectives, outlined in the table below. The initial intention was to gain an overview, from graduates, of the MCB programmes and to ascertain whether there really was anything 'special' about placement learning. A second intention was to gain some insight into analytical themes which might be appropriate for use in the major, longitudinal study into the MCB programmes as a whole; these themes are considered further in Chapter 5. In addition, this phase of the research provided the opportunity to test and amend the research methodology.

Group characteristics, research objectives and the nature of data collected during the supplementary studies are outlined over the page:

Table summarising supplementary research

Group	Characteristics	Research Objectives	Data collected
1. G1-11	Eleven graduates (**G**) from the 1994 intake who graduated in 1997 and 1998. 4 males, 7 females. 10 undertook placements. All placements were UK-based.	To obtain a quick, retrospective overview of the MCB course from those who had had time to reflect on their experiences. To help focus the enquiry. To pilot the use of questionnaires.	Responses to an email questionnaire (Appendix 2.1).
2. IR1-17	Seventeen undergraduates newly returned from placements, 2002. 4 males, 13 females. 7 on the Masters programme, 10 studying for BSc. 10 UK-based placements, 5 in the USA and 2 in Europe.	To obtain immediately retrospective (**IR**) views of placements. To pilot open questioning. To continue the process of idea focussing.	Responses to general enquiries and questionnaire, by email (Appendix 2.2).
3. DP1-16	Sixteen undergraduates during placements (**DP**), 2003. 5 males, 11 females including 1 mature woman. 11 on the Masters course, 5 studying for BSc. 9 UK-based placements, 6 US and 1 Canada.	To obtain contemporaneous views of placements. To continue the process of focussing and category finding.	Responses to unstructured email requests for information. Notes from some individual meetings.

Note that the higher number of female respondents reflects the female bias amongst undergraduates of Molecular and Cellular Biology at the University of Bath.

GROUP G: Retrospective study, with graduates, of the role of placements within Molecular and Cellular Biology programmes, 1994-1998, including placement year 1996/7

The eleven people involved in this study came to the University of Bath as undergraduates in 1994 to study Molecular and Cellular Biology and replied to a letter, sent to their last known home address, asking them to participate in this research. There were 24 of us in this cohort and a response rate of over 45% was pleasing, after so long. There were four males and seven females. One did not do a placement, and graduated in 1997, while the other ten took the sandwich degree and graduated in 1998. Five of these graduates went on to study for PhD/DPhil in MCB-related areas. This group responded to an email questionnaire (Appendix 2.1) in Autumn 2001, i.e. three or four years after graduation. This group of respondents is referenced by G (graduates) 1-11.

Data

As stated before, data are sometimes displayed in tables, where each row represents one student's input. However, the method of reporting the majority of data uses a narrative style with quotations. Within normal text, each pair of quotation marks (‘ ’) contains the words of a single respondent. Where quotations are bulleted, each bullet point indicates quotations from a single student. Three dots … within quotations indicate omissions, square brackets [ ] enclose words added by the author and (?) indicates words unclear on audio tape or whose meaning is unclear in email text. Some spellings have been corrected, e.g. definately is replaced with definitely, but otherwise the text comes from the respondents and the use of CAPITALS or punctuation (!) is theirs.

a) On university-based elements of the course

Group G views on lectures and lecturers' styles were summed up by two graduates as 'Varied a lot. Some very interesting, some terrible' (G1) and 'There was a huge range of styles and quality of lectures' (G2). When asked '*Did you learn a lot from lectures?'* all graduates said yes and most added that they probably learnt more from their own work subsequently, with notes, textbooks and references. One graduate wrote that 'Although I rarely felt I had learnt much in a lecture … it helps in giving you a framework, even if you quickly forgot the detail' (G2). G5 wrote that it took him a long time to get the hang of lectures, that 'It's important not to get too bogged down in the little details that can be irrelevant and to get a grasp of the whole picture! This took me a good 6-7 months to come to terms with. Also very often the lecture will only be the bare minimum of the subject and, to really understand it, you will have to go and do further reading. This took me half of my first year to come to terms with!'

Comments on personal tutors and tutorials were typified by 'Reasonably helpful' (G3) and 'OK but not particularly useful' (G2).

When asked '*How did you find practical classes?*' responses were less consistent, with two graduates remembering them as 'A lot more fun than lectures. They were the highlight of the week' (G4) and 'Quite a good laugh' (G5), while the majority wrote as follows:

- 'Terrible, always copied results' (G1).
- 'Almost without exception, a complete waste of time … it gave me absolutely no useful training for working in a lab[oratory]' (G2).
- 'Normally we failed miserably to get things to work! But between 5-6 of us we could get the right answers we were supposed to have!' (G5).
- 'We often fumbled our way through … with little guidance' (G6).
- 'On occasions formulated the results entirely from my imagination' (G7).

- ‘Practical classes in the first year were a bit of a nightmare because there were so many people in the class’ (G8).
- G10 ‘Felt that we were lumped with the biochemists and biologists too frequently and that there were too few practicals aimed directly at MCB students’. She wanted ‘More molecular biology-based practicals, e.g. PCR, site-directed mutagenesis and blotting etc [rather] than enzyme assays and physiological practicals’.
- ‘I used to dread them and the main aim would be to leave as quickly as possible … I rarely knew what I was doing until afterwards, when trying to write it up! Also calculations were a complete mystery to me and I always got someone else to do them’ (G9).

This last graduate, now a postdoctoral research scientist, went on to write ‘I now think that practical sessions are essential and I actually wished that we’d had more of them. Learning through actual hands on sessions really works and I think that I was always nervous because I was inexperienced’ (G9).

When asked whether their time at the University of Bath was positive or negative overall, each graduate wrote that it was positive and some that it was very much so, e.g. ‘Incredibly positive, best years of my life’ (G6). There were a few general criticisms, though, e.g. ‘Not enough feedback, never knew WHY an essay was good or bad’ and ‘Some things on the course were a waste of time, e.g. organic chemistry’ (both G1). Another graduate criticised the organisation of the MCB course, writing ‘Things sometimes seemed a bit of a shambles’ (G3); in 1994 the course was quite new.

b) <u>On placements</u>

One respondent did not go on placement. She had originally enrolled for the three-year course but considered changing to the sandwich course. When she told the then Director of Studies (Placements) that she might, after all, like to do a placement she was told that ‘might’ did not sound like enough commitment and she was not given the opportunity to apply for a placement.

This graduate regretted her lack of placement long afterwards, even after successfully completing her PhD (G3, meeting 15/12/2001).

The other ten graduates experienced placements, all of which were UK-based although some (G1, G4) had hoped to work abroad. These graduates were asked about their placement experiences and '*Did you learn a lot, in the broadest sense of learning … about life as well as MCB-related?'* Their responses are summarized in table form overleaf.

Table of placements undertaken in 1996/7

Ref	Host institution	Type of work	Negative comments	Positive comments
G4	Pharmaceutical company, neuropharmacology	Research project	None.	'It was fantastic!' 'Had to grow up quickly and be responsible for my own projects.'
G1	Government research, Microbiology	Routine, repetitive	'Used by supervisor as menial labour'.	'Worthwhile nonetheless … gained lab skills, work skills.'
G2	Animal health research institute	Repetitive work + small project	'I thought it would be easier and I didn't expect to have to work [under] supervision as much as I did.' Regretted the placement did not involve MCB techniques.	'Generally a good experience.' 'I gained in confidence and independence both in and out of work.' 'I probably wouldn't have persisted with the PhD if I hadn't had the experience of my placement.'
G5	Company, R&D of assays	Research/development of assays	'Homesick' … had to leave university friends and 'start all over again.'	'Allowed me to build a much broader scientific knowledge base and brought a lot of things I had learnt into context.'
G10	Children's Hospital	MCB research but no clearly-defined project	Learnt little except laboratory skills.	'On the whole' a good experience.
G6	6 months food research agency 6 months company Microbiology	Microbiology research	None.	'Work that had real purpose … with great people and lots of support from my managers.' 'Learnt how to behave in a professional environment.' 'Both were excellent – really worthwhile personally and academically.'

Continued - Table of placements undertaken in 1996/7

Ref	Host institution	Type of work	Negative comments	Positive comments
G11	Hospital	Routine chemical analysis	Thought a research-based placement would have been better.	Developed skills in 'communication, responsibility, working as a member of a team, planning and time management.'
G7	Horticultural research (6 months only, due to illness)	Horticultural research, low-key project	'I wasn't presented with any responsibility and my project was quite low-key.' Learnt 'not as much as I could have.'	'It gave me a clear picture of what I didn't want to do when I left Uni.' 'MCB-wise it was very beneficial and helped me enormously with my final year project.'
G8	Pet food company	Product development	None.	'It was very valuable. Would definitely recommend anyone to do it.' 'Most enjoyed the business and management side … decided I'd do that after university.'
G9	Pharmaceutical company, Neuroscience	Research project	None.	'Practical skills, approaches to experiments, calculation ability and problem solving all improved 100%. Learnt how to communicate scientifically.' 'The placement was undoubtedly the best aspect of the whole degree – absolutely invaluable. Without it – I'm not sure how good a scientist I'd be.' 'STUPENDOUS in every way!'

The table above shows that Group G respondents were often positive about their placements; some reported finding their placements very beneficial to their learning and made no negative comments. Of those comments which were negative, three refer to the type of placement work students were called upon to do, while one experienced feelings of homesickness.

Findings from Group G data

a) Retrospective overview of university-based MCB learning.

This small study of alumni confirmed that teaching and learning in lectures, tutorials and practical classes within their degree programmes had similar shortcomings to those identified in the literature within other HE institutions and other programmes (discussed in Chapter 2).

Graduates reported learning a great deal from lectures and individual background work; the first two years of university-based study must, therefore, provide much useful background knowledge of Molecular and Cellular Biology for students entering their third year of study or placement work.

None of the graduates had particular praise or criticism for the tutorial system; perhaps those who make specific demands on their tutors may gain most, e.g. in terms of pastoral care, but there were no data on this.

Graduates' memories of practical classes held in 1994-1996 reflect two different viewpoints, with some graduates remembering practical classes as 'More fun than lectures' (G4) and 'A good laugh' (G5) while others were highly critical of their laboratory-based experiences at university; G2 found them 'A complete waste of time' and G9 'Used to dread them'. Why should there be this disparity? A closer look at the critical remarks gives some insight into student perspectives. There is a suggestion, from G10, that practical classes involving enzyme assays and physiology may not have been seen as relevant to molecular biology. Graduates' recollections of

fumbling through 'With little guidance' (G6) and that 'I rarely knew what I was doing … calculations were a complete mystery' (G9) suggests that practicals did not encourage their learning, while mention of copying or formulating results (G1 and G7) to 'Get the right answers we were supposed to have' (G5) suggest that these sessions were perceived to be more about producing expected results than about experimentation and discovery. The fact that those graduates who were most critical of practical classes are those who went on to postgraduate study or work in scientific disciplines, suggests that they had a genuine interest in practical scientific work and might have been capable of taking deep approaches to their learning in practical classes (Marton and Säljö 1976).

b) Retrospective overview of placements

Graduate feedback on placement experiences was interesting in several ways. Firstly, many graduates wrote enthusiastically about their placements and all ten saw their placements as worthwhile learning experiences. However, it appears that the type of work undertaken on placement had some bearing on the learning outcomes; those whose work was routine, repetitive or 'menial' (G1) were noticeably less enthusiastic than those who had worked on their own projects or 'work that had real purpose' (G6) and reported learning 'Not as much as I could have' (G7).

Graduates wrote of gaining practical laboratory skills and work-related skills. In addition, they referred to professional learning such as 'Broader scientific knowledge base' (G5) and of learning 'How to behave in a professional environment' (G6). One 'Probably wouldn't have persisted with the PhD if I hadn't had the experience of my placement' (G2). Another graduate, who found her placement 'STUPENDOUS in every way' wrote that 'Approaches to experiments, calculation ability and problem solving all improved 100%.' 'Learnt how to communicate scientifically' and added that 'without it – I'm not sure how good a scientist I'd be' (G9). Graduates also referred to gaining confidence, independence and maturity. Their use of words and phrases like 'fantastic' (G4), 'excellent, really worthwhile personally and academically'

(G6), ‘very valuable’ (G8) and ‘undoubtedly the best aspect of the whole degree – absolutely invaluable’ (G9) strongly suggests that placements and placement learning make a significant contribution to undergraduate learning.

Responses from Group G graduates, although retrospective, do seem to suggest that some placements resulted in significant learning which was qualitatively different from that gained through traditional university-based teaching.

In addition to providing data on MCB undergraduate learning, including placement learning, the supplementary study afforded the opportunity to test the research method and enabled initial focussing.

Research method

Questioning graduates provided a useful overview of the MCB course. In addition, their detachment and honesty revealed what current undergraduates may be reluctant to admit, e.g. copying or inventing results and getting other people to do their calculations. However, graduate memories may not accurately reflect their contemporaneous views of university or placements; studies with undergraduates addressed this.

Email responses were a successful method of data collection. Questionnaires were useful but some questions were more productive than others. In general, the more open questions yielded more interesting information and had the advantage of allowing respondents to give their own descriptions of their experiences. For example, ‘*Did you learn a lot from lectures*?’ and ‘*How did you find practical classes*?’ were productive questions. On the other hand, a question intended to reveal learning of life-skills and which mentioned maturity, independence, time management and communications before asking ‘*what words would you use to describe the effect placement had on you?’* was of very little value as several respondents wrote ‘All of the above’ and failed to add their own words. Another question that did not work well asked students whether they were learning in great

depth and detail or learning more broadly about many things and elicited the response 'Bit of both really'!

Some respondents preferred answering questions to free composition and would ask for specific areas of enquiry but the remaining research always sought students' own words and usually avoided leading questions.

Focussing

The type of work offered on placement (i.e. individual projects and/or menial work) seems to have had some influence on the quality of placement experience and on placement learning; this theme will be pursued. There also needs to be some analysis of what is learnt on placement, as well as on the nature of that learning. Only after these matters have been established can consideration be given to those factors that might promote or inhibit placement learning and to the differences between placement learning and that from university-based practical classes.

GROUP IR: Immediately retrospective study of placement learning, 2001/2

The previous study group consisted of graduates whose memories of the MCB programme were some three or four years old. Group IR, by contrast, consisted of seventeen undergraduates (out of twenty-two on placement that year, a response rate of over 77%) who provided feedback immediately at the end of their placements undertaken in 2001/2. There were thirteen females and four males. Ten placements were undertaken in the UK and seven abroad, five of those in the United States and two in Europe. One of the students who worked in Europe spent 6 months in France and 6 months in Germany while the other spent a year in France. Ten of these undergraduates were studying for BSc degrees and seven for the undergraduate Masters degree. This group is referenced by IR (immediately retrospective) 1-17.

Data were collected by email. Since I particularly wanted their own words, without the external prompting of questions, students were asked to tell me '*Your main impressions of your placement - what was the most important part of it for you, how did you feel about it generally, was it a useful learning experience?'* (August 2002) before opening a questionnaire attachment (Appendix 2.2).

Data

Spontaneous comments were as follows:

Several Group IR students wrote of unpleasant and unsettling feelings initially, saying that a placement environment was very different from that at university. They used words like 'stress' (IR1), 'turmoil' (IR2) and 'overwhelming' (IR3), for example 'My first thoughts on arriving in the States was that I had made a major mistake … very much alone … totally swamped' but overall it was an 'Absolutely wonderful year' (IR4).

Remarks on learning included these from four students: 'Had to trouble-shoot my experiments when they failed and learnt not only MCB techniques but the theory behind them' (IR4), 'In-depth (often one-to-one) teaching' (IR1), 'Hands on … much easier way of learning' (IR5) and 'Learnt loads from people I've worked with' (IR6).

Supervisors were frequently mentioned, both positively and negatively. Some were liked and admired for their knowledge and enthusiasm but two respondents wrote of supervisors who gave them only menial tasks. One said her supervisor was 'Difficult to talk to … found myself less motivated to work for him' (IR7) and the other felt her 'Learning was hindered by [her] supervisor' (IR8); both of these students decided, while on placement, to leave science after graduation.

Many students wrote, without prompting, of the beneficial effect the placement had on their confidence, maturity, responsibility and independence.

Responses to the questionnaire are summarized below. The following pages give an outline of undergraduates' placement experiences in 2001/2 where, as before, each row contains the comments from a single respondent, followed by a page outlining something of what was learnt by placement students, collectively, in terms of those skills used in Molecular and Cellular Biology and in working environments generally and demonstrates the wide range of experience and skills gained by students who undertook placements.

Table of placements undertaken in 2001/2, immediately retrospective data

Ref	Host institution and Country	Type of work	Negative comments	Positive comments
IR9	Agrochemical company, UK	Various projects	Stress (with housemate)	'The main thing I have gained is self-belief that I can do this job.'
IR4	University research, US	Research project	'Thrown in at the deep end' 'Started out as a lonely place … didn't feel like I would ever belong.'	'Working on your own project … makes you think through what you are doing and why you are doing it.' 'I grew a lot in my placement … keener to take on a PhD.' 'I gained a true insight into the professional world of science … however I gained most personally … most amazing experiences and met wonderful people.' 'Helps cement knowledge into your head.'
IR3	Children's research hospital, US	Research project	'Wasn't' quite prepared for how daunting the whole experience would be.' [Felt] 'overwhelmed', 'lonely … homesick.'	'There's no doubt that the whole year contributed a lot towards my academic studies … learnt a lot from working in the lab, both practically and in increasing my knowledge on the academic side of MCB.' [My supervisor] 'inspired me … to continue in the research field.'
IR10	Children's research hospital, US	Research project	'To start with it was very bizarre.'	'Valuable learning experience both in and out of the lab.' 'Great learning experience as it is all hands on and a case of learning from mistakes and that really makes the lesson stick.' 'Useful contribution to my academic studies because it made me use theories which I had obtained during my previous years and improved my lab knowledge.' 'I now have a better understanding of a researcher in the field of MCB.' 'The most important part was becoming more confident.'

Continued - Table of placements undertaken in 2001/2, immediately retrospective data

Ref	Host institution and Country	Type of work	Negative comments	Positive comments
IR11	Small biotech company, UK	Research project	'Being dropped in at the deep end was not appreciated … steep learning curve.' 'Hard going and lonely at times.'	'My supervisor was … very patient and a great mentor.' 'It has made me more responsible and mature … more driven to achieve a career in something that I enjoy.'
IR1	6 months international research laboratory, France and 6 months university research, Germany	Project Repetitive, routine work	'Disorientation in the beginning; loneliness … helplessness … desperation'.	Of the project – 'challenge … exciting', 'better: own project … involve thinking of my own'. 'Supervisors … experts in the project … give more detailed knowledge.' 'A major point aiding my learning was the friendly atmosphere … frequent interactions with colleagues … definitely promoted my learning.' Placement showed her that the motives behind science 'Are by no means always honourable and selfless … driven by money and its pursuit'. She wanted a career in medical research with 'Direct (!!!) relevance' for patients.
IR5	Biotech company, UK	Routine work	'Most let down academically … did not do a proper research project.'	'Hands on approach [is] a much easier way of learning.' Felt she benefited from 'one to one tuition … no pressure asking questions.'
IR12	University research, US	Research project	'Spend all day, every day on my own, there is nobody to talk to … it was a shock.' 'Stressful … not sure I was totally ready to run a project like this on my own.'	'A bit more confident … enhanced my interest in this type of work and given me the information to seriously consider what a PhD involves.' 'I have enjoyed doing my own research and being left to be independent … satisfaction with working hard to get the research right.'

Continued - Table of placements undertaken in 2001/2, immediately retrospective data

Ref	Host institution and Country	Type of work	Negative comments	Positive comments
IR13	Pharmaceutical company, UK	Research project	'Quite lonely for much of the year.'	'One-to-one teaching and people were always around and willing to help.' 'Although I learnt a lot academically, I think that I got the most out of my placement personally … it made me more confident and independent.'
IR8	Agrochemical company, UK	Routine, mundane, repetitive	'Needed more mental stimulation.' Supervisor was 'very arrogant … found it hard to respect him.'	None.
IR7	University research	No project, routine	Monotonous. 'I found this very frustrating.' 'My boss was a nightmare … all sweetness and light one minute and then really nasty and snappy the next.' 'My main task each day was to do everything in my power to avoid my boss.'	'Everyone was lovely except my boss.' 'Social life was really good … able to join the university sports clubs and use the facilities.'
IR14	Food research, UK	Research project	'Thrown into the deep end.' There was a poor working atmosphere with 'unhappy people', 'stress' and 'friction.'	'My project supervisor was a very nice person, quite laid back, with a good sense of humour!' 'Would now consider doing research after graduating' whereas before the placement 'working in a lab had started to fill me with horror.'
IR15	Pharmaceutical company, UK	Research project	None.	'My supervisor was excellent … very enthusiastic about his research which helped to motivate me.' 'I'm considering a PhD which I would not have prior to my placement.' 'Helped me become familiar with the biological language and associated jargon.' Gained 'useful insight into what an MCB job will be like.'

Continued - Table of placements undertaken in 2001/2, immediately retrospective data

Ref	Host institution and Country	Type of work	Negative comments	Positive comments
IR2	Pharmaceutical company, US	Initially menial work, then research project	Company was in turmoil. Hated being 'Lab Whore'. 'Having to be on my own and make a life for myself was hard. It was an alien environment and took a lot of getting used to.'	Project was 'challenging', 'great fun … overall experience was totally invaluable.' 'Personal development was the largest factor [gained]'.
IR6	Pharmaceutical company, UK	Research development of assays	None.	'I don't think I could have made it more positive!' 'Learnt loads from people I've worked with.'
IR16	Cancer research laboratory, UK	Research project	None.	'I gained more understanding and knowledge as I had my own project … greater interest to look into my work and its background.'
IR17	International research laboratory, France	Routine research projects	'Work [was] tedious … depressed me immensely.' 'It didn't allow me to develop concepts and link biological information.' 'Interesting lab work is an oxymoron.'	'Helped me grow as a person, especially being out of the country … I grew ten years in experience and maturity.' 'Certainly a change to escape my old influences and really discover myself … facilitated by several people I met … with more life experience, who are more cultured, more intelligent and quite inspiring.'

Work undertaken and skills acquired by placement students 2001/2

MCB-related:

Basic laboratory techniques (e.g. pipetting, centifugation, making up solutions, pouring agar plates, a-septic techniques).
Tissue culture, bacterial cell culture.
Bioinformatics.
Immunology, immuno assays, immunofluorescence.
Staining techniques.
Microbiology.
PCR (polymerase chain reaction), primer design.
DNA sequencing.
Microscopy, electron microscopy, fluorescence microscopy.
Agarose and polyacrylamide gel electrophosesis.
DNA and RNA extraction and purification.
Restriction enzyme digests.
Western blotting.
Mass spectroscopy.
In situ hybridisation.
Toxicology.
The use of various analytical machines.
Literature searching, scientific writing.
Micro arrays.
Enzyme assays.
Protein concentration – serial dilutions, standard curves and sample analysis.
Cloning, sonication and transfection.
Protein expression, purification and crystallisation.
Yeast two-hybrid screening.
Antibiotic discovery.
Chromatography.

Work-related:

Being able to work independently, to think for myself.
Team working.
Awareness of office politics, interpersonal skills, the ability to get along with less cooperative colleagues. Awareness of how competitive science can be.
Ability to interact with other people on a more professional level.
IT skills (Excel, Access, PowerPoint, etc).
Presentation skills (posters, lab meetings)
Organisation skills, planning ahead, time management.
How to be careful and consistent, attention to detail.
Problem-solving, trouble-shooting.
Record keeping, documenting results.
Project planning.

Once again, positive comments on placements outweighed the negative in most cases. Exceptions were IR8, who had a supervisor viewed as 'Arrogant' and who 'Needed more mental stimulation', IR7, who disliked and avoided her boss and IR17 who found his work tedious and depressing. Issues of disorientation and loneliness were raised again (e.g. IR1, IR11, IR12) and some students disliked 'Being dropped in at the deep end' (IR11. Also IR14 and IR12).

Positive comments refer to exciting projects (IR1), 'Excellent … very enthusiastic' or inspirational supervisors (IR15 and IR3) and to personal growth and development (e.g. IR4, IR10 and IR17).

Findings from Group IR data, immediately post-placement

A number of themes emerged from Group IR data, including the following:

a) <u>What was learnt on placement?</u>

The list of skills acquired by placement students in 2001/2 is quite straightforward. Depending on the type of placement work undertaken, students became familiar with a number of techniques used in Molecular and Cellular Biology and this alone makes their placements worthwhile. Such a list would be essentially similar each placement year; it reads like the index from an MCB laboratory manual. In addition to MCB-related skills, students gained some understanding of the world of work and some useful work-related skills. This work experience is comparatively easy to assess (Davies 1990) and makes graduates with placement experience better able to tackle their final year projects and more sought-after by employers (Kelly 7/8 April 2001). Some students also wrote of gaining confidence, maturity, responsibility and independence.

b) Nature of work and placement learning

The rest of the data are complex but some themes are identifiable. Firstly, many students seemed to equate research-/project-based placements with a qualitatively better placement experience and viewed more routine work as less satisfactory; this is interesting when so much of what research work entails is itself routine and mundane. Students with personal projects wrote 'I gained more understanding and knowledge as I had my own project' (IR16) and 'Own project … makes you think through what you are doing and why you are doing it' (IR4) while those with more monotonous work wrote:

- 'It depressed me immensely … didn't allow me to develop concepts and link biological information' (IR17).
- 'Needed more mental stimulation' (IR8).
- 'Found [monotonous work] very frustrating' (IR7) and
- 'Most let down academically … did not do a proper research project' (IR5).

Students who did both types of work were clear which they preferred; one hated being 'Lab Whore', doing mundane chores for an hourly fee, but enjoyed his project and wrote that the 'Overall experience was totally invaluable' (IR2) while another wrote 'Better: own project … involved thinking of my own'; she found the 'Challenge … exciting' (IR1).

c) Other factors affecting placement learning

Students identified a number of factors, in addition to the type of work, which helped their learning. For example, 'Great learning experience as it is all hands on and a case of learning from mistakes and that really makes the lesson stick. Useful contribution to my academic studies because it made me use theories which I had obtained during my previous years and improved my lab knowledge' (IR10) and, from another student, 'A major point aiding my learning was the friendly atmosphere … frequent interactions with colleagues … definitely promoted my learning' (IR1) and another 'Hands on

approach [is] a much easier way of learning'; this student felt she benefited from 'One to one tuition' and from 'No pressure asking questions' (IR5).

There was further explanation of supervisors of whom students were critical; 'Very arrogant … found it hard to respect him' (IR8) and, from another student 'My boss was a nightmare … all sweetness and light one minute and then really nasty and snappy the next' – although she says 'Everyone was lovely except my boss' (IR7); she goes on to write that her main task each day was to avoid her boss. References to supervisors with whom students had a good relationship included, from one student, 'He's inspired me … to continue in the research field' (IR3), from a second, 'He was very patient and a great mentor' (IR11) and, from a third 'My supervisor was excellent … very enthusiastic about his research which helped to motivate me … I'm considering a PhD which I would not have prior to my placement' (IR15).

Students used some strong words to describe their sense of disorientation such as 'Alien environment' (IR2), 'Bizarre' (IR10) and 'Wasn't quite prepared for how daunting the whole experience would be. [Felt] 'overwhelmed', 'lonely … homesick' (IR3). This disorientation was, of course, more frequent among students experiencing culture shock on placements abroad but home-based placements involved it to some degree too. IR11 was on placement in the UK but wrote that 'Being dropped in at the deep end was not appreciated … steep learning curve'. Such negative emotions did not stop students looking back on their placements as mostly positive overall. It seems that unpleasant memories of disorientation may fade over time; Group G hardly mentioned them four years after their placements and Group IR saw placements as positive, immediately afterwards, despite initial problems. The work of Piaget and Lewin suggests that such dis-equilibrium or unfreezing could have a beneficial effect on learning.

Finally, it is interesting to note the way in which placements affected some students at the personal level and changed their views of themselves or the world:

- Several students, who had not done so before, were considering doing postgraduate research (IR4, IR12, IR14, IR15) while three (IR7, IR8 and IR17, see below) had decided that such a career was definitely not for them.
- IR11 became 'More driven to achieve a career in something that I enjoy'.
- IR1 learnt that science was sometimes driven by money but that she wanted a career with 'direct relevance' for patients.
- 'I grew ten years in experience and maturity … really discover[ed] myself' (IR17).

This last student wrote with real passion on his placement, which he loathed, and his year of social experiences, which transformed his life. Of his working life he wrote that it was 'Depressing, tedious, pedantic, pathetic and insane', that 'There was no kind of team work … and even less communication'. He went on to write that people used meetings to 'Bitch at each other', that 'Interesting lab work is an oxymoron' and that 'It helped me to decide that I never want to work in a lab … probably put me off science for life'. He wrote of his social life, by contrast, as being 'Intense, eye opening, spectacular, interesting, fun, emotional, almost spiritual', that he 'Met some amazing people … very interesting, intelligent and great fun' and that his placement year 'Dramatically changed [his] life in a positive way … and I am forever changed because of it.' It seems that this placement was poor, even mis-educative, but that this student's social life while on placement provided the opportunity for informal learning of a transformational nature.

Group IR data given above suggested a number of categories for further investigation, including learning by doing, working atmosphere and social interactions with colleagues, supervision, disorientation and the effect placements can have on students at a personal level.

* * * * * * * * * *

Both of the previous studies were retrospective. Since retrospective views of placements may differ from contemporaneous views, the next small study

looked at students' experiences of placements while they were happening, roughly halfway through their placements. Also, since I had been impressed by the richness of students' comments unprompted, Group DP placement students were not given a questionnaire but were asked for their 'current views' and 'how you FEEL about the placement'.

GROUP DP: Study of Students' Experiences during Placements in 2002/3

Sixteen students (out of eighteen on placement that year, a response rate of over 88%) responded to an informal and unstructured email request for information about their placement experiences, while they were experiencing them, in Winter 2002/3. There were eleven females, one of whom was a mature woman, and five males. Seven of the placements were abroad, six in the United States and one in Canada (where the English student's parents were living). Eleven were on the Masters programme and five were studying for BSc. This group is referenced with DP (during placement) 1-16.

Data

The tables on the following three pages give an outline of undergraduates' placement experiences in 2002/3.

Table of placements undertaken in 2002/3, views during placements

Ref	Host institution and Country	Type of work	Negative comments	Positive comments
DP6	Agrochemical company, UK	?	'Not enjoying having to get up and go to work every day'	'All my supervisors are really nice and helpful.'
DP7	Developmental Neurobiology research, US	Research with project	None.	Working with 8 people who all get on well together. Boss 'is a great lab head. Busy … quite often at work over 11 hours each day … work's very interesting … so I don't have a problem working long hours'.
DP4	Neuroscience research, US	Research project	'Didn't know what to expect in America … distant and unknown. It wasn't that easy to adjust into American culture'. Initial homesickness. 'Laboratory life is frustrating!' Lack of supervision was a problem at times, when he ran into problems.	Everyone really friendly … willing to help. Being treated like an adult … had to do most things myself which is great! Looked up and learnt the whole procedure myself. His project was 'particularly interesting' and 'I understand it inside out'. 'It wasn't until I came on placement that I realised its massive importance.'
DP8	Developmental Biology research, US	Research project	'People often assume I know how to do something … don't explain it very well … hard to feel able to ask questions.'	'Everyone very welcoming … nice working atmosphere'..
DP9	Neurobiology, Children's hospital, US	Routine initially, then research project	Initial chaos, boredom and 'starting to despair'. Not sure who to go to with questions. Would like to be 'pushed' more. Sometimes lonely.	'Project more interesting, much happier now. Brilliant institution. Boss is very good - very intelligent and knows a lot about theory'. This student really liked America, 'everyone friendly and helpful'.
DP11	Biotechnology, UK	Routine plus project	'Bit lonely'. Had a bad patch of low lab confidence, then OK.	Supervisor is 'very lovely … look up to her, made me feel part of the team'. Social life good.

Continued - Table of placements undertaken in 2002/3, views during placements

Ref	Host institution and Country	Type of work	Negative comments	Positive comments
DP10	Fertility clinic, US	Routine and later projects	'Initial settle-in really tough, a lot harder than I imagined'. Routine work less enjoyable, less motivating. Problems with distance learning - see forward.	'Really enjoyed interacting with patients. More to do so you're kept interested'. Excellent social life, 'I love it here'.
DP2	Immunology company, UK	Routine plus project	Considering 'play: work balance' and her future career – maybe investing in property.	'Learning on my placement comes from putting into practice what I've heard about academically at uni but didn't quite understand 'til I actually did it! … Learnt a lot from listening to colleagues … like doing GCSE Spanish and moving to Spain. You just pick it up subconsciously'.
DP12	Cellular Biology, Children's hospital, Canada	Research project	None.	Working with 15 people 'from all over the place … really great mix of cultures'. Of his boss 'I really do admire the guy, he's top of his field and you can tell … excellent manner with people. I feel this placement was an absolute find. It's given me an opportunity to experience not only the type of work I enjoy, and will probably go into, but also the lifestyle and the people in and with which I'd like to do it'.
DP3	Microbiology company, UK	Project	None.	'Work is really interesting … can't believe how much I've learnt'.
DP13	Child Health Institute, UK	Routine then 2 projects	Living at home is 'tricky'.	'Thoroughly enjoying my placement … it's been very helpful' (with regard to work and future career plans).

Continued - Table of placements undertaken in 2002/3, views during placements

Ref	Host institution and Country	Type of work	Negative comments	Positive comments
DP14	Medical Science research, UK	Research with project	'As a mature student, it has been difficult at times to cope with domestic problems and a placement.'	'Most important year of my course and most enjoyable. Helped bring together the information learned before to understand the research I am undertaking now'. Doing her placement converted this student to laboratory research work and made her consider a PhD.
DP15	Pharmaceutical company, UK	Research project	None.	'Lot of responsibility, nice challenge, excited about what the study will show'. Hoped to publish a paper or two. 'Lucky with my team … lovely people. The company is very keen on providing placement students with opportunities … we were told this year is for OUR benefit!'
DP16	Toxicology, UK	Routine sample analysis	None.	'Thoroughly enjoying my placement. Extremely interesting. London is brilliant.'
DP1	Molecular Biology research, US	Research with project	Very lonely and missed her boyfriend 'an awful lot'. Hell with roommate. Project was boring, repetitive. Decided she now wants a 9-5 job and a life.	Initially enjoyed the work and 'research here is really interesting'.
DP5	Pharmaceutical company, UK	Research project	'Feel I'm expected to know more than I do. My supervisor is quiet … difficult to talk to … [initially] I felt I was more of a burden'. Distance learning interfered with the job - see forward.	'It's definitely the best opportunity I've had and the work here is far more interesting than the lab work at uni!'.

Five of the sixteen students, all of whom were on placement in America, mentioned initial feelings of being unsettled (DP4, DP9, DP10, DP1 and DP8). Three of those on placement in the UK had problems with loneliness or domestic arrangements (DP11, DP13 and DP5). Two respondents, with rather different placements, felt they were expected to know more than they did (DP8 and DP5). Two of the Masters students were having difficulty with the distance learning required for their course; one had no access to appropriate library material but did have a laptop computer (DP10), while the other had no computer at home, no internet access from home and no suitable library nearby so found university work interfering with her placement work (DP5). Two further comments, negative with regards to a future in MCB, came from people who had mostly repetitive work; one of them had decided on a nine to five job and 'a life' (DP1) and another was worried about 'play: life balance' (DP2) and had decided not to pursue MCB as a career.

Eleven undergraduates referred favourably to the people with whom they interacted. Conversely, the one who found her placement year most difficult (DP1) mentioned missing her boyfriend, having problems with her roommate, and having no friends to socialise with. She described herself as not particularly outgoing.

Once again research projects were described as 'Really interesting' (DP1, DP3) or 'Particularly interesting … it wasn't until I came on placement that I realised its massive importance' (DP4) and, from a third student 'Work here is far more interesting than the lab work at uni!' (DP5).

Findings from Group DP data, during placements

Interestingly there was no noticeable difference between responses during placement and those immediately retrospectively, or between the two consecutive placement years, 2001/2 and 2002/3. The same general themes were mentioned by both groups of placement students:

a) Disorientation

The theme of disorientation was clear once again. I must repeat, however, that in many cases the feelings of being unsettled, lonely, homesick or culture shocked, which students experienced as negative, were not necessarily detrimental to their learning and may have facilitated it (Piaget's dis-equilibrium, Lewin's unfreezing). Students abroad mentioned feelings of disorientation more than home-based ones, for example 'Didn't know what to expect when I arrived in America … somewhere distant and unknown … it wasn't that easy to adjust straight into the American culture' (DP4) and a well-travelled student, who had previously lived abroad, wrote 'Initial settle in really tough, a lot harder than I imagined' (DP10). In most cases this phase was relatively short-lived; students seemed to find it stressful but not excessively so. However, one student, who described herself as 'Not a particularly outgoing person', had a difficult time throughout her year in the United States. She had real difficulties making friends 'That I can do things with outside the lab, and there's not much for me to do on my own' and suggested that other students in the same situation 'Should probably be more outgoing than me' (DP1).

b) Supervisors, colleagues and learning

The role of the supervisor and other colleagues was referred to frequently and so was the working atmosphere or ethos. 'The lab I'm working in has about 8 members. We all get on well together. [The supervisor] is a great lab Head. He's very excited about the work … always has many good ideas' (DP7). Another student wrote that she 'Learnt quite a lot here from listening to colleagues talking about antibodies all the time' (DP2). One wrote that her boss was 'Very good, very intelligent and knows a lot about theory' (DP9) and another that her supervisor was 'Very lovely. I do look up to her quite a lot and she made me feel part of the team' (DP11). Another wrote of her supportive supervisor who 'Likes to leave me to do as much of my own work as possible … a lot of responsibility … a nice challenge'; she added that she was lucky with her team 'They are all lovely people' (DP15). The student in

Canada wrote of working with 'About 15 people, each of which I now know pretty well … from all over the place … It makes for a really great mix of cultures.' He admired his boss very much, saying 'He's top of his field' and 'It really gave me a buzz' and, when the boss spoke highly of this student's work to other colleagues, it made him feel 'That what I was doing was really having an impact' (DP12).

Placement learning was described in a number of ways. The comment from DP2, who wrote that learning (about immunology, in this case) from listening to colleagues was 'Like doing GCSE Spanish and moving to Spain. You just pick it up subconsciously', was interesting. I believe that this student was comparing learning at university with learning a foreign language for a GCSE exam and contrasting it with learning in the culture where that language is spoken 'for real' in everyday interactions; this suggestion that her placement learning came about by immersion in the language and culture of her placement environment resonates strongly with Vygotsky's socio-cultural theories of learning. This student also wrote 'A lot of learning on my placement comes from putting into practice what I've heard about academically at uni but didn't quite understand 'til I actually did it!' One student who regretted having limited supervision and 'Basically looked up and learnt the whole procedure' himself, said the advantage of this independence was 'I don't just know the technique I am doing, I understand it inside and out and have become confident enough to discuss it with other professors' (DP4). The UK-based mature student said her placement 'Has helped to bring together all the information learned from the previous two years to use as a background to understand the research I am undertaking now' (DP14). The general tendency of students with research projects to write more, and with more enthusiasm, than those with more mundane placement work was evident again but there was one exception; servicing machines, routine sample analysis and what he called 'General odd jobs' suited one student perfectly . He wrote enthusiastically about it as being 'Extremely interesting' and thought the experience would 'Prove to be invaluable … it will certainly help me in my final year, especially with my project' (DP16).

c) Placement effects at the personal level

The student who worried about her 'Play: work balance' had just turned twenty-one and was feeling she 'Should be living life to the full – not stuck in an office/lab, being too tired to go out in the evenings!' Her placement 'Opened [her] eyes to how some people invest so much time into pursuing their careers and have very little time to enjoy themselves' and she wrote that 'It seems the people who make a lot of money (and therefore have the freedom to enjoy themselves) are the ones who aren't pushed into further education' (DP2). Her placement apparently made her consider her own priorities for the future.

Other inter- and intrapersonal effects were reflected in the following:

- 'It wasn't until I came on placement that I realised its massive importance.' This student referred to himself as 'Being a molecular biologist' (DP4).
- 'I feel this placement was an absolute find. It's given me an opportunity to experience not only the type of work I enjoy, and will probably go into, but also the lifestyle and the people in and with which I'd like to do it' (DP12).
- 'This has been the most important year of my course, as well as being the most enjoyable … previously, laboratory practicals had made me question whether I would like to work in research. My placement … has completely altered my opinion and I would now look forward to taking part in further research' (DP14).

d) Distance learning

Students on the Masters programme had to complete distance learning modules while on placement. This was sometimes problematic. One student wrote, of distance learning, that 'I thought … it wasn't supposed to interfere with our job [but] without a computer at home, access to the internet or a decent library, it was very difficult to complete the problems out of work

hours' (DP5) and another student wrote that her placement institution in America was 'Not affiliated to any university so I have had no access to any biological library and of course I did not bring any textbooks' (DP10).

* * * * * * * * * *

The three additional studies, taken together, provided the background to the main, longitudinal study that followed. Chapter 4 has been little more than a survey of students' views and experiences but the data does suggest placement learning can be highly significant. In some cases placements appear to have been highly beneficial to undergraduate learning of Molecular and Cellular Biology. In others, though, students reported learning relatively little and, in a few cases, students found themselves in situations which were mis-educative (Dewey 1938) and learnt more about their 'life-world'. The reasons why students' placement experiences seem to be so varied need further consideration.

In addition, piloting of research methods suggested that email can be a valuable method of data collection and that open questioning can provide a richness of data. More importantly, data from these three groups of research participants brought into focus those aspects of MCB students' experiences which seemed to be important in seeking to answer the research questions posed in this thesis.

What students learnt from their placements included MCB-related skills and competences, as demonstrated by the list generated from 2001/2. Many students also reported gaining work-related skills; this aspect of placement learning is already covered in the literature on placements (e.g. Davies 1990). Both MCB and work skills are Barnett's 'knowing how' (1994). As well as the acquisition of skills, some students reported increased academic and professional knowledge (Barnett's 'knowing that').

In addition to these previously recognised aspects of placement learning, some students reported that their placement experiences had dramatic

effects on them personally, their concepts of themselves, their learning and their relationship with the rest of the world (their 'stances'. Savin-Baden 2000).

Students' descriptions of their learning processes during placement have identified some themes for analysis, including disorientation, the type of work undertaken, supervisors and supervision, working environments/cultures, learning by doing, learning from mistakes (trouble-shooting, problem-solving) and so on. Links or relationships between themes may help to identify factors that may facilitate placement learning or inhibit it.

In addition, students in the supplementary studies compared university-based practical experience - often using derogatory words like 'terrible' (G1), 'dread' (G9) and 'horror' (IR14) - with practical work on placement - 'Far more interesting than the lab work at uni!' (DP5), 'Nice challenge, excited' (DP15), 'Keener to take on a PhD' (IR4) and 'I'm considering a PhD which I would not have prior to my placement' (IR15); other students also reported that their placement experiences had motivated them to consider studying MCB at postgraduate level (e.g. IR12, DP14). Possible reasons why university-based and placement-based practical experience are viewed so differently will be one of the areas examined in the longitudinal study.

In the following chapter the preliminary findings outlined above will be reflected upon, in the light of the literature on learning, in order to clarify the understanding gained so far and consider how it can inform the main study into undergraduate learning at programme level.

CHAPTER 5: MAKING SENSE OF PRELIMINARY FINDINGS

This chapter is a reflection on the empirical data from the supplementary studies reported in Chapter 4 and on the themes emerging from these data. Since the majority of data reflected on in this chapter are those from Chapter 4, where each quotation was referenced to an individual participant, most words and phrases have not, this time, been referenced. Where there is additional material, providing more detail than was given in the previous chapter, it is of course referenced.

Reflection had three aims. The first was to clarify and explain my thinking; were the data beginning to make any sense? The second was to relate the empirical data to learning theories in the literature; which theories 'fit' with the empirical data and which might not? [I felt in a much better position to define my own theoretical perspective, after doing some practical research, than I had before, after an initial literature review.] Thirdly, what relationships, if any, were there between emerging themes; how might it all fit together? Additionally, I needed to bear in mind the relevance or otherwise of emerging analytical categories for analysis of the main longitudinal data, in order to answer the research questions about undergraduate learning from university-based learning opportunities.

Much of what participants had written about their placement experiences, in the supplementary studies, could be explained in terms of socio-cultural theories of learning. There is, however, some overlap between learning theories; it seems that, while there are differences between one theory and another, there may be agreement in principle and that areas of disagreement sometimes stem merely from a difference in emphasis or from differences in research perspectives.

One approach which did, however, seem to be radically different from the others was Howard Gardner's idea of multiple intelligences (Gardner 2003). It is more about types of knowledge, knowledge domains and ways of knowing than about the process of learning and did not, initially, seem to

resonate with preliminary data. I considered rejecting Gardner's ideas yet it would patently be wrong to study placement learning while ignoring knowledge. This forced me to return to consideration of the nature of knowledge and led me to start modelling my thoughts.

It is my belief that models often have rather more meaning for their inventors than for subsequent readers and that this is especially so when the model is complex. Consequently, I originally had no intention of designing a model of placement learning and yet, during the process of repeatedly moving between data and literature, one emerged. While trying to conceptualise my developing ideas I used PowerPoint software. This facilitated visualisation, but also clarification, of my thoughts; PowerPoint functioned as both a physical tool and a psychological one. The resultant model grew out of the preliminary data but illustrates how the many constructivist and socio-cultural theories might fit together. It is consistent with the preliminary data but also with the views of Piaget and Vygotsky, amongst others, and, although it incorporates many components, it has an underlying simplicity.

Early drafts of the model proved useful as an aid in discussions with colleagues in the Department of Education at Bath and at conferences (British Educational Research Association, Manchester, September 2004, and the Society for Research into Higher Education, Bristol, December 2004) and, more importantly, with the research participants themselves; 'more importantly' because those who had provided the data were best placed to say whether the model explained their views of their learning experiences, i.e. whether it made sense or non-sense to them (Silverman 1997). One of the 1998 graduates, G9, kindly provided written feedback on the model (email 1 March 2004) and, since she was then a post-doctoral supervisor of placement students, could consider the model from two perspectives. Several students in the longitudinal study (L1, L3, L9, L11 and L12) provided feedback by email from their placements and at a meeting (Autumn 2004). These exchanges led to development and refinement of the model. It may evolve further, in the future, or be replaced, but described below is the working model at the time of writing of my understanding of learning derived

from placements and one which made sense to research participants. The model led to a new framework for analysis which was then tested in the longitudinal study.

A Learning Equation

In creating the model my starting point was epistemology, a consideration of the nature of knowledge and what it means to learn. It is now generally accepted that learning is a constructive process whereby individual learners build personal mental models with which they understand or make sense of their experiences. This can be represented by an equation as follows:

The arrow to the right indicates the innate human tendency to construct mental schema as a way of understanding and making sense of lived experiences. 'In psychology, schema is a term used to refer to knowledge structures in which the parts relate to one another and the whole in a patterned fashion' (Mandler 1985, p 125). 'Some schemas serve to help us recognize objects, make judgements, comprehend stories and otherwise act in the world. Schemas are important knowledge structures that enable us to deal effectively with the information processing demands of a large and complex world. They serve to extract and categorize clusters of experiences in that world!' (Anderson 1980, p 158).

New experiences, if familiar, are assimilated into similar but more comprehensive frameworks but placement students often reported the unfamiliar, using words like disorientation, loneliness, helplessness, desperation or overwhelmed, and describing their placement situation as an alien environment, distant and unknown. Under these conditions, unfamiliar experiences cause existing frameworks to be broken down and

reconstructed, so that new knowledge is incorporated, with pre-existing knowledge, into altered schema for better understanding the world.

The reverse arrow in the equation above is intended to illustrate 'dis-equilibrium' but it must be viewed with care. It does not illustrate **un**-learning (which would be forgetting) but a process of **re**-learning, of new ways of understanding in the light of new experiences.

Piaget's work suggested that a period of dis-equilibrium, when existing frameworks are challenged or shaken before being reconstructed in more complex forms, can be beneficial for learning, although the process may be uncomfortable for the learner. The degree of disorientation was often greater for students on placement abroad than for those staying in the UK and one could postulate that this is why the experience of working and studying abroad often gives an added dimension to learning. It seems that dis-orientation could be one factor promoting placement learning.

The equations illustrate a dynamic situation with potential for change, for learning, but what might promote or inhibit learning and how might it come about? These questions will be considered next.

Promoters and Inhibitors of Learning

Participants in the supplementary studies repeatedly identified two factors which promoted their placement learning. They wrote that the work they undertook while on placement could be a powerful promoter of learning. Having an individual project seemed to be one of the most significant aids to learning; example quotations from two students were 'Working on your own project … makes you think through what you are doing and why you are doing it … helps cement knowledge into your head' and 'I gained more

understanding and knowledge as I had my own project … greater interest to look into my work and its background'. These students (and others) seemed to echo the elements of Kolb's learning cycle here, referring to doing, thinking about what they were doing, thinking about why it might be so etc. The learning they described was more than just the acquisition of technical skills necessary to do a job ('knowing how'), it also involved background knowledge and understanding ('knowing that', Barnett 1994).

Having nothing but repetitive routine work, on the other hand, had little beneficial effect on placement learning. One respondent wrote that 'Interesting lab work is an oxymoron', that tedious work 'Depressed [him] immensely' and 'Didn't allow [him] to develop concepts and link biological information'. It seems that this student was capable of taking a deep approach to his placement learning but the type of work he was given did not allow him to develop the concepts and links he sought (Marton and Säljö 1976 and 1984). The 'Activity Theory' of Vygotsky and Leontiev also gives central importance to learners' involvement in purposeful collective work (Engeström, Miettinen and Punamaki 1999); engagement in activity which the student considers worthwhile can, it seems, drive the learning equation towards the right. The specific nature of the work students were involved in did not seem to matter. Placement students seemed to learn just as long as they were engaged in work they felt had real purpose, regardless of the type of work. Interestingly, students do not complain of boredom during research-based placements, despite the fact that much MCB research is quite repetitive, but they do mention boredom when their work is seen as mundane and does not engage their interest.

According to Kozulin 'the concept of activity has been extremely difficult for Soviet psychologists to define clearly … this category has undergone a metamorphosis and has been the subject of so many disputes [since Vygotsky] suggested that socially meaningful activity (*Tätigkeit*) may serve as an explanatory principle in regard to, and be considered as a generator of, human consciousness' (Kozulin 1996, p 99). In this thesis the 'activity' undertaken by placement students is completion of their placement work,

often a research project. This activity forms part of the work of their host institution, e.g. the ongoing work of a research laboratory. My research project studied students' perceptions of their individual placement situations, rather than the Activity Systems of which they formed a part, where 'activity' would have a wider definition. Placement work involved students in a variety of, let's say, 'actions' e.g. technical procedures, working at laboratory benches and with computers, culminating in the writing of their placement reports.

That learning came from practical activity is illustrated by the following examples:

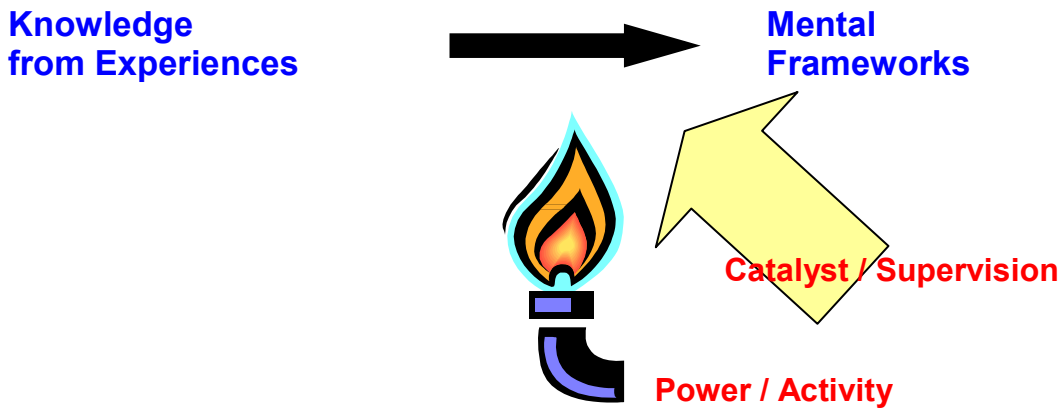
- 'Learning on my placement comes from putting into practice what I've learnt about academically at uni but didn't quite understand 'til I actually did it.'
- 'Had to trouble-shoot my experiments when they failed and learnt not only MCB techniques but the theory behind them.'
- 'Great learning experience as it is all hands on and a case of learning from mistakes and that really makes the lesson stick … it made me use theories which I had obtained during my previous years and improved my lab knowledge.'

The effect of doing meaningful work can be likened to the flame of a Bunsen burner that provides power to a chemical reaction and drives it forward; it is more difficult to learn if that flame is low or out altogether.

Respondents sometimes reported that another promoter of placement learning was a good supervisor. Good supervisors were described as 'friendly', 'helpful' and 'approachable'. Students often had great respect for their supervisors and valued their enthusiasm. One student wrote that his supervisor was 'One of the most intelligent guys I know', another that his 'Really knows what he is talking about and has an immense knowledge' and a third student said of his 'I really do admire the guy, he's top of his field and you can tell.' On enthusiasm, one student wrote 'My supervisor was

enthusiastic about it, which helps, as this enthusiasm is then passed on to you'.

It appears that a challenging project, undertaken with good supervision (see forward), provides a strong push towards learning. These promoters can be modelled by adding to the learning equation as shown below:



Note that respondents gave the greatest priority to the type of work that they did, rather than to the supervision that they received. Empirical data therefore suggests that the primary category for analysis of placement learning should be learner activity, with supervision having secondary importance. Interestingly, much of the literature in higher education focuses on teaching first and foremost, rather than on learner activity or even on learning.

Students sometimes referred to the absence of supervision: 'I knew I was making unnecessary mistakes and doing experiments that needn't be done' and, from another respondent, 'I really needed someone who knew about [the research] to tell me if the data was good'. One student who wrote of a lack of supervision 'Looked up and learnt the whole procedure' himself yet grew to 'Understand it inside out'. It seems that good supervision can catalyse (promote, facilitate) the learning process but that students are able to learn without it. Vygotsky wrote that 'Learning awakens a variety of internal developmental processes that are able to operate only when the child is interacting with people in his environment and in cooperation with his peers. Once these processes are internalised, they become part of the child's independent developmental achievement' (1978, p 90); it appears that

such interaction does not have to be provided directly for literate learners but can come indirectly through 'looking things up' in books or on the internet.

There were a few examples of poor supervision, on the other hand, which suggest that it can inhibit learning:

- 'I felt my learning was hindered by my supervisor as I felt he used me almost as cheap lab labour … I would generally have to do what I was told. I felt he held me back from doing other things and learning new techniques despite me asking to do other stuff' (IR8, September 2002).
- 'My boss was difficult to talk to and was very often away. He refused to give me a project of my own … I found myself less motivated to work for him' (IR7, September 2002).

The supplementary data suggest a hierarchy of learning potential between placement situations in at least two distinct areas, activity and supervision. Fortunate students have interesting research projects and work under good supervision, the less fortunate have a worthwhile project but poor supervision or good supervision but mundane work. Students with routine work and poor supervision are at a disadvantage and might well struggle to derive much useful learning from their placements. In terms of the model, their learning equation might be expected to proceed slowly because they have neither power to drive it forward nor the catalyst to help it proceed at low power.

The complex process of learning Molecular and Cellular Biology (or anything else for that matter) cannot, of course, be represented by a single simple equation. A more realistic representation would consist of very many equations in a complex system of reactions with a range of different components and products and might look similar to the huge wall charts of metabolic pathways seen in the offices of Biochemistry professors. Howard Gardner's 'multiple intelligences', by which he means an individual's facility for learning different types of knowledge (the 'kind of mind' a learner has, Gardner 2003), could be likened to their strengths or weaknesses in different learning pathways, resulting in a variety of products or learning outcomes.

Placement students reported that they acquired practical skills (requiring dexterity and bodily-kinaesthetic intelligence), scientific language or jargon and communications skills (linguistic intelligence). Some wrote of gaining organisation skills, planning ahead, time management (perhaps temporal intelligence could be added to Gardner's list). In addition, some developed their powers of scientific reasoning, e.g. 'Approaches to experiments, calculation ability and problem solving all improved 100%' (logical-mathematical intelligence) and underwent changes in the way they interact with others (interpersonal) and/or view themselves (intra-personal). For example:

- 'Although I learnt a lot academically, I think that I got the most out of my placement personally … it made me more confident and independent.'
- 'Helped me grow as a person, especially being out of the country … I grew ten years in experience and maturity. [It was] certainly a change to escape my old influences and really discover myself … facilitated by several people I met … with more life experience, who are more cultured, more intelligent and quite inspiring.'

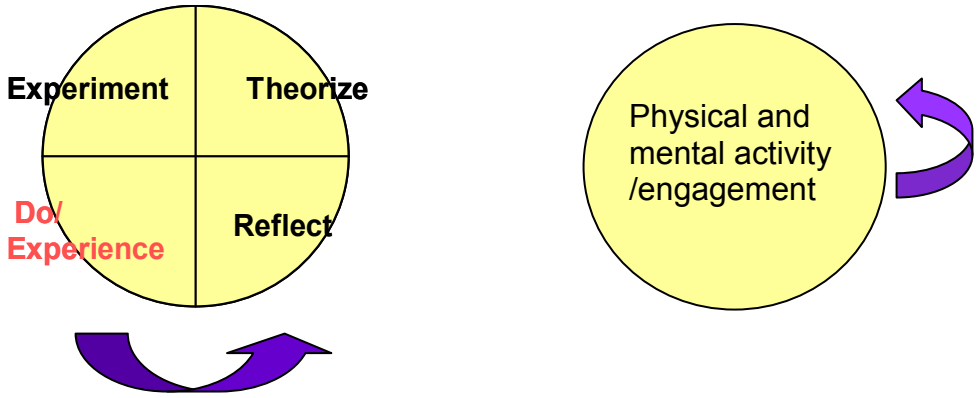
The learning outcomes derived from placements, whether a particular student gains more scientifically or personally, could be seen as depending partly on their placement activity and supervision and partly on their individual profile of multiple intelligences.

Learning Processes

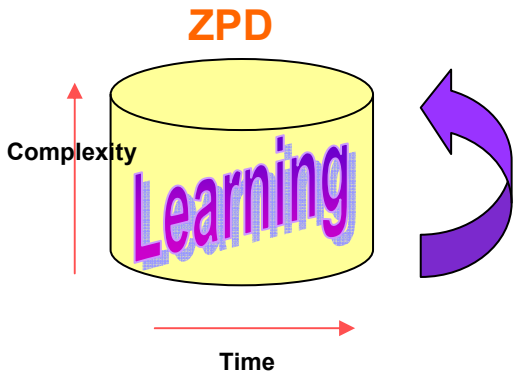
The next phase of the model depicts the processes by which learning occurs; in a sense it is a closer look at the forward arrow in the learning equation. The idea that learning involves progression through the learner's Zone of Proximal Development (ZPD), is so central to current learning theory that it seemed the best way to begin this part of the model. Vygotsky defined ZPD as the distance between actual development and the level of potential development under guidance or in collaboration with more capable peers and went on to state that the ZPD 'defines those functions that have not yet

matured but are in the process of maturation, functions that will mature tomorrow but are currently in an embryonic state' (Vygotsky 1978, p 86). In terms of placement learning the ZPD is the distance between a second-year undergraduate's understanding and the knowledge and ability which that student possesses after a year of placement experience, when they may have gained enough experience to be primary author of a peer-reviewed scientific paper. How, then, might a zone of proximal development be illustrated? I began with a circle. There must surely be some association between the ZPD and the work or task that both placement students and activity theorists suggested as the basis of learning. Certainly both believed that learning frequently begins by doing or experiencing and so too did Piaget and those whose focus is experiential learning. Doing by itself is not, however, enough to ensure learning. There must also be reflection and internalisation; Dewey pointed this out in the 1930s and placement students wrote that the important part of having a project was that it made them think. Therefore, all the aspects of learning sometimes described as the learning cycle (e.g. by Kolb 1984), could perhaps be aspects of learning within the ZPD.

The diagrams below show ZPDs, initially as a pie chart divided into equal sectors of Doing/Experiencing, Reflection, Theorising and Experimentation (after Kolb). Learners usually favour one or two of these aspects over the others and this preference is sometimes referred to as an individual's learning style (e.g. Honey and Mumford 1982); it results in pie chart sectors of unequal size. The various aspects of the learning process mean that learning can take place without 'doing', through refection and theorising. In any case, it is not always possible to separate doing and thinking when, as Barnett puts it, 'doing at any level of complexity involves thinking, and thinking conducted with any seriousness is a form of action' (Barnett 1994, p160); the regions of the learning cycle merge into one another.



Going round and round the same learning cycle has a reinforcing effect. In this way skills become automatic ('like riding a bicycle') and neural pathways are strengthened, but mere repetition does not result in growth and development. In order for learning to advance, it has to be a cumulative process of revisiting knowledge at ever-higher levels of complexity over time as learners progress across their zones of proximal development (Vygotsky 1978). ZPDs could therefore be represented as three dimensional and the learning process as spiral as it is in the next few pages:



Placement students are usually helped and supported by their supervisors as they progress through their placement ZPDs. Supervisors are more capable in their own field of study than their new placement students and assist them to gain expertise (Tharp and Gallimore 1991). The data showed that good supervisors did more than provide interesting projects, they also provided initial help for their students in a variety of ways, including explanation, demonstration and instruction, and encouraged students to respond by imitation and questioning.

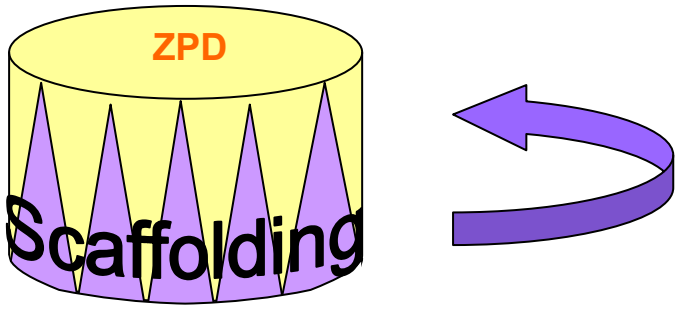
- ‘She explained things clearly [and] demonstrated techniques and then let me copy her, which I found a brilliant way to learn’ (IR7, Sept 2002).
- ‘I worked quite closely with [my supervisor] to start with and she explained everything in particular detail. I had a lot of one-to-one supervision which was good. I always had someone there to answer my questions’ (IR3, Sept 2002).

Good supervisors also know when to withdraw and let the student operate more independently. There is a dialogue between them that allows the supervisor to judge the appropriate level of support required. David Wood refers to ‘contingent’ instruction and to fading out so that the learner ‘is never left alone when he is in difficulty, nor is he ‘held back’ by [supervision] that is too directive and intrusive’ (Wood 1998, p100). Placement students seem to benefit from both the initial supervision and its withdrawal.

- ‘The work became more challenging as the project progressed and I was left to use my own initiative and design my own experiments’ (IR3, Sept 2002).
- ‘My project was quite challenging as I had to do almost all of the work on my own, after I had been shown how to do it’ (IR13, Sept 2002).
- ‘There is a huge plus point for what you get out of this independence. I don’t just know the technique I am doing, I understand it inside out and have become confident enough to discuss it with other professors’ (DP4, Feb 2003).
- Another student who enjoyed independence wrote that he ‘Had to think pretty hard about what I was doing’ (IR12, Sept 2002).

The ‘scaffolding’ of good supervision could be thought of as a supportive framework, around the ZPD, which is thicker and stronger at the base, when the student is a novice, and fades out towards the top, when the student has some expertise and can operate independently (Wood and Wood 1996). In this way placement learning becomes embedded, internalised, integrated

with previously gained university knowledge and students gain not merely skills but real understanding. The 'scaffolding' which supports a student, particularly at the beginning of their placement ZPD, is illustrated below:

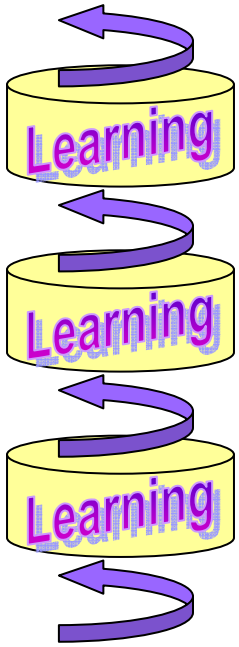


Care must be used when thinking of 'scaffolding' and the solid staves drawn above are somewhat misleading. Scaffolding is not a rigid framework dictating the formation of a pre-determined edifice but a flexible support enabling the construction of individual personal learning. The type of support students valued during their placement learning was rarely physical and more usually emotional or psychological. They said they gained from encouragement, enthusiasm and such, e.g. 'It was fantastic being with people who were so enthusiastic about their subject and brimming with energy all the time. It is very easy to be swept up in the excitement' (IR10 Sept 2002).

Good supervisors gave students work to do which was close, or 'proximal', to their current ability to perform but which stretched them and encouraged them, with assistance, to advance their understanding towards the next level. Suitable work would not, though, be so difficult as to generate excessive stress, which inhibits learning; students preferred to feel challenged, not terrified. One respondent wrote that 'Being dropped in at the deep end was not appreciated … steep learning curve … hard going'. On the other hand, mundane and repetitive tasks seemed to generate boredom and resentment, 'Needed more mental stimulation'. In the words Vygotsky used about instruction, it seems that placement work 'is good only when it proceeds ahead of development, when it awakens and rouses to life those functions which are in the process of maturating or in the zone of proximal development' (Vygotsky 1956, p 278).

There would seem to be an optimum level of difficulty, somewhere between 'Being dropped in at the deep end' and being under-stimulated and bored, where students were comfortable yet challenged and where their learning potential was likely to be maximised.

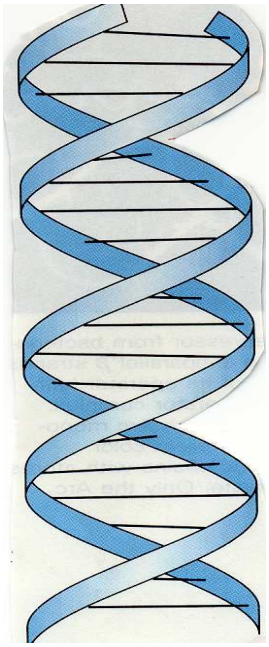
At each stage of personal development, it seems, the student or learner builds on previous knowledge and experience, adding new concepts, to create more complex mental frameworks. Learning is a spiral process of revisiting knowledge at ever higher levels of understanding. These incremental stages in understanding resonate with Piaget's work on stages in child development (Wood 1998) and with William Perry's on changes in undergraduate thinking over time (1970), as well as with Vygotsky's ZPDs. Learning is usually a stepwise process.



Learners experience phases of dependence and independence and may be independent operators in one area while being dependent on assistance in others. More able students are able to learn more, with assistance, than others and this could be thought of in terms of taller or shorter zones of proximal development.

Adults, with their accumulation of experience, are at a higher level in a greater number of learning areas than children. ZPDs are totally individual, different in different people depending on their experience and ability. One example from my childhood illustrates this well. My mother used to tell of a humiliating day, for her, which began when I was apparently shocked to discover that she didn't know the Lord's Prayer in French, which I had learnt at school. Later she overheard my brother telling a builder 'My Mummy

doesn't know a thing about tools'. My mother's discomfort arose because her children's Zones of Proximal Development lay in different areas of expertise from her own.



Learning and emotions inter-twined

Empirical data from supplementary studies had indicated that learning and emotions are inextricably interwoven; when asked open questions about their learning, students reported feeling excited or bored, enthused or depressed, confident or depressed. For this reason, a spiral diagram of the learning process seemed incomplete and a double-helical structure, with the learning process intertwined with and cross-linked to an emotional strand, was a better representation of the two aspects that together regulate learning in the same way that the double helix of DNA regulates the cell.

Learner Individuality

The double-helical part of the model illustrates learner individuality. Learners vary in their natural intelligence (as could be shown by taller or shorter ZPDs), in their individual potential in different knowledge domains (their multiple intelligences, perhaps differing heights of ZPDs in different knowledge areas) and their areas of expertise and ignorance (higher ZPD stacks in some areas and lower in others). One participant in the longitudinal study was prompted, by the model, to write 'I have been told that, for a student to fully appreciate the placement, in terms of understanding and progress, he needs to have both the "ability" and the "spark". Some have the ability but no spark - no motivation or thought - to do it intuitively, whereas others have the spark but are not very good at assimilating the knowledge and techniques' (L3, September 2004).

It is not only ability that is individual and variable. Learners also vary in their emotional and psychological profiles, depending on previous experience, perspectives and stances etc. Together these two strands are likely to be as distinctive and personal as a DNA profile. Therefore it seems that another important category in the analysis of undergraduate learning should be learner individuality. Interestingly, this part of the model is also the area most frequently picked up for discussion by peers and colleagues when I present my work. People seem to relate well to a double-stranded model of learning and emotion, perhaps because emotions have been a somewhat neglected area in recent literature on learning. In the past, though, John Dewey (1938), Carl Rogers (1983) and many others have pointed out the importance of viewing learners holistically. Some neuroscientists are also interested in the link between emotions and feeling and our ability to reason, e.g. Damasio believes that the Cartesian separation of mind and body was wrong and that cognitive abilities and emotions may be bound up together in the brain (1994, 2001).

How a student feels about and reacts to their learning environment is likely to stem partly from the environment itself and partly from the student's personal profile. Both external (environmental) and internal (individual) factors have an influence on student goals, their engagement with the work, their motivation and so on. In the case of the placement student who avoided her boss, their poor relationship could have stemmed either from a difficult student or from a poor supervisor and the only data available are the student's words. Here I expand on data given earlier:

> 'Everyone was lovely except my boss … Everyone walked on eggshells around [him] … My direct supervisor, a post doc, was lovely … My boss, a professor, was a nightmare. He was all sweetness and light one minute and then really nasty and snappy the next … No one in the lab had a very good rapport with him from what I could make out' (IR7, September 2002).

In this instance, I am inclined to think that the boss was probably not ideal. In others, of course, problematic students might create difficult relationships between themselves and their supervisors.

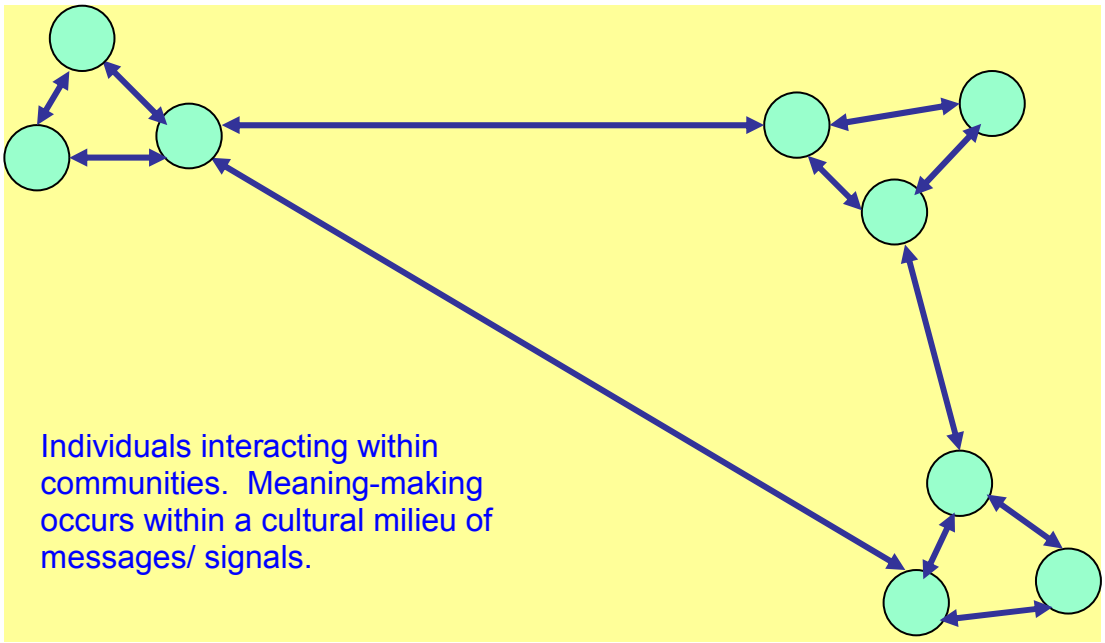
It would, theoretically, be possible to arrive at a hierarchy of students whereby those of high innate ability or intelligence, a background of positive learning and life experiences, positive attitudes and approaches, and high motivation are likely to have greater potential in a given learning situation than those with lower ability and so on. Student psychology, personality, intelligence and biography are often neglected in learning literature, perhaps because of the difficulties involved in accessing and evaluating matters of mind and emotion and/or the level of complexity such matters would add to the already complex problem of trying to understand learning. This research project does not attempt to redress the balance yet it would be wrong to ignore learner individuality. For this reason, the longitudinal study included student profiles in the hope of gaining some insight into the attributes and characteristics of individual students, as well as using 'Learner individuality' as a major analytical category.

Socio-Cultural Contexts of Learning

So far, the model has considered promoters and inhibitors of learning, has looked at the processes involved and at learner individuality but has not yet explained the disparity that sometimes occurs between the learning outcomes envisaged by the University, when arranging placements, and the fact that some students actually report learning very little. This disparity can be better understood when the social contexts of placements and students' perceptions of their placement environment are taken into account, as in the case of IR7 above, who felt she learnt relatively little from her placement and wrote 'My main task each day was to do everything in my power to avoid my boss'. Boss-avoidance was patently not the intended outcome from her placement but became so because of her feelings towards her supervisor. Her placement became, in Dewey's word, 'mis-educative' because of the dislike she developed of her supervisor. The question of intended and actual

learning outcomes will be tackled again in Chapter 7 (in terms of espoused theories and theories-in-use). As Entwistle and Ramsden (1983) and Biggs (1978) discovered through research with students within a university setting, it is the student's *perception* of their situation, and how they feel about it, which provide their local context and determine both their approach to learning situations and their actual goals. For this reason it matters, it is *important*, whether a student is happy or miserable, whether they are bored, challenged or over-stressed during their placement.

The one-to-one relationship between placement students and their supervisors was not, of course, the only social and cultural influence reported by respondents who frequently referred to learning from colleagues. This accords with Vygotsky's socio-cultural theories of learning. The simple diagram below is a starting point for consideration of the influences of the wider social and cultural environment on students' placement learning.



In this diagram the green circles represent individual learners. People/ learners are grouped into small communities that form part of a wider society. The arrows symbolise means of communication between people, the reciprocal influences they have on each other. Messages are exchanged through language (dialogue), texts, signs and tools - both material and psychological; these are the means by which people come to understand

each other and the world in which they live. Although many writers focus particularly on the role of speech and language in learning, Leontiev pointed out that 'In practice non-verbal modes of intercourse occur quite frequently in communication' and added '(according to some psychologists, nearly 40% of information is transmitted in this way)' (Leontiev 1981, p 24).

Individuals move between groups, having a different role in each setting. An undergraduate of Molecular Biology, for instance, may have roles within their peer group of MCB students, in a group sharing student accommodation, in a sports team, the choir, etc. at university, as a placement student working in a hospital, as a family member at home, and so on. This involvement in a number of different social settings has been called personal trajectories of participation (Dreier 1999).

The yellow background colour in the diagram is significant. It indicates the cultural milieu which surrounds us all. Its influence is diffuse but pervasive. Culture has been thought of in a number of ways. Michael Cole wrote of culture as creating 'an artificial environment where young organisms could be provided with optimal conditions for growth' and went on to state that 'such tending required tools, perfected over generations and designed for the special tasks to which they were put' (Cole 1996, p 143). Learners are affected by the historical background of the environment in which they find themselves, acting through cultural artefacts which carry meaning (messages). To continue the analogy of the culture medium a little further, cultural artefacts influence the identity of individuals within that culture in much the same way that growth factors in a cell-culture medium can influence cell differentiation; these signalling molecules (messages) have dramatic effects on internal activity and structure, influencing not merely morphology but role and function. They help to determine what a cell becomes. In human terms, socio-cultural mediation dictates not only what is learnt but how knowledge comes to be understood and, ultimately, the very identity of the members of the society and their collective culture. Considering learning in 'communities of practice', Lave and Wenger wrote

that ‘learning and a sense of identity are inseparable: They are aspects of the same phenomenon’ (1999, p 31).

Vygotsky emphasised the significance of mediation. What humans do, how we act, and what and how we come to learn and understand, is mediated through socio-cultural interactions. According to Kozulin (1998), Vygotsky envisaged three classes of mediators: material tools, psychological tools and other human beings. In other words, we derive our understanding from cultural artefacts which embody meaning, through conceptual tools (which help us organise our thinking, including language) and through interactions with other people. ‘Artefacts’ include physical tools (the matter we handle and work with) and ways of thinking. Human beings are surrounded by sources of information and, despite some of the messages being very subtle (for example, some behaviour and body language), we are adept at deriving meaning from our environment.

Placement students interact and become familiar with the artefacts associated with molecular biology laboratories (equipment, procedures, techniques, other scientists, dialogue, texts, computers etc) and their useful knowledge usually increases. ‘Productive activity and understanding are not separate, or even separable … using artefacts and understanding their significance interact to become one learning process ... [as learners] participate in information flows and conversations, in a context in which they can make sense of what they observe and hear’ (Lave and Wenger 1999, p 27).

Learning is facilitated by good communication. One to one communication is part of effective supervision, as outlined above, but an expanded communications network is also helpful to placement learning. Respondents who complained of little supervision were, nonetheless, able to learn a great deal from their placement work because they sought help from their peers and ‘Looked up and learnt the whole procedure myself’; it seems that support can come from several sources, not just from the supervisor, and even indirectly, through reading, internet searches etc (i.e. in the diagram of

learning mechanisms, the separate staves of 'scaffolding' can come from different sources). In my view, scaffolding is a problematic word and 'mediation' is better for describing the support around a ZPD; as I see it, support from a supervisor or more capable other is a particular form of mediation. 'Mediation' (rather than 'supervision') therefore emerges as the second major analytical category in this analysis of student learning.

Several students gave examples of effective social interactions. For example, 'Frequent interactions with colleagues definitely promoted my learning' and 'I feel I've learnt loads from people I've worked with'. Others pointed to the lack of interaction 'Spend all day, every day on my own, there is nobody to talk to … it was a shock', or to inadequate interactions 'People often assume I know how to do something … don't explain very well … hard to feel able to ask questions'. That the influence comes from communications was shown by the remarks of two students, in particular; one said that his placement helped him 'Become more familiar with the biological language and associated jargon' and another that 'Listening to colleagues talking about antibodies all the time … it's a bit like doing GCSE Spanish and moving to Spain. You just pick it up subconsciously'.

We all contribute to and take from the culture in which we live and, in so doing, may change its nature in more or less subtle ways (evolution or revolution). Much of the time we conform to the norms of our society and perpetuate its characteristics but sometimes there is non-conformity. As Lave and Wenger put it 'knowers come in a range of types, from clones to heretics' (1999, p 31).

The diagram above is necessarily a gross over-simplification because it soon becomes confusing when more circles are added and the lines of communications are drawn between them. Individual learners are subject to an extremely complex set of socio-cultural influences. In each case, though, the strongest and most obvious influences are between the learner and those closest to them in a given situation, be it their colleagues, peers, family or friends. For example, students in the setting of a professional placement,

such as a research laboratory, develop 'ways of thinking and practising' appropriate in that context (McCune 2003):

- 'I gained a true insight into the professional world of science.'
- 'Learnt how to behave in a professional environment.'
- 'It's given me an opportunity to experience not only the type of work I enjoy, and will probably go into, but also the lifestyle and the people in and with which I'd like to do it.'

Three examples demonstrate how students were affected by the more diffuse influence of working culture or ethos, in these cases nurturing environments:

- 'It was a very relaxed atmosphere … people are so friendly, it makes you want to go to work and do the best you can, not just for yourself but so you don't let the others in the team down' (IR10, September 2002).
- 'The people I worked with were very chilled and relaxed and I found this was the best way to get work done' (IR6, July 2002).
- 'This company [a multinational pharmaceutical company] is very keen on providing placement students with the opportunity to experience as much as we can in the time that we're here … we were told that this year is for OUR benefit and we should try to exploit [the company] as much as possible! My team frequently repeat this to me. I have indeed been trying to make the most of my time here by attending seminars, presentations and tours as well as talking to people about what they do and how they do it' (DP15, February 2003).

It is interesting to note that these students equated situations which were 'chilled and relaxed' with motivation to go to work and with getting work done and that a company which is successful in a highly competitive area felt able to encourage students to use the placement for their own benefit. The influence of a contrasting environment is illustrated but the experiences of IR17: 'There was no kind of team work at all and even less communication. Group meetings [were used to] just bitch at each other. [The atmosphere

was] typically scientific - big ego's, ambitious people who want to be famous in their field … big divides and communication problems.' It is hardly surprising that this placement, which I would define as mis-educative, made this student decide that he 'Never want[ed] to work in a lab ever again and has probably put me off science for life' (September 2002).

There is, it appears, a hierarchy of learning potential from different placement environments, depending on their cultural norms. Supportive and relaxed working atmospheres, with ample social interaction and friendly communication between colleagues, seem to provide a nurturing culture medium where students thrive and grow, while competitive environments may have impaired communications and reduced learning potential or the potential for mis-education.

The ethos of different placement institutions, and the cultural signals embodied within them, help students to gain knowledge and understanding of aspects of their world to a greater or lesser extent. In some cases, students are influenced at a deep personal level. One student wrote of discovering himself, another of finding 'Not only the type of work I enjoy, and will probably go into, but also the lifestyle and the people in and with which I'd like to do it' and a third was made aware of the ethical aspects of career choices as follows:

> 'The motives behind [science] are by no means always honourable and selfless. A lot of science is driven by money and its pursuit … became even clearer to me that I do not want to be doing science simply for the sake of knowledge that has no further relevance other than being marketable … ambition to go into medical research that has direct (!!!) relevance to and promotes practical applications for patients' (IR1, September 2002. Original punctuation).

The social and cultural aspects of learning form the final part of the model which emerged from preliminary empirical data. In large part, the model coincides with many learning theories from the literature; often these are not

mutually exclusive but merely different in emphasis, stemming from researchers' disparate views of the whole picture. Piaget's focus was that of individual development. Vygotsky, Leontiev and Luria, however, looked at Activity Systems and socio-cultural influences on learning (at 'Mind in Society') as did Lave and Wenger, whose 'Communities of Practice' (1999) are similar to Activity Systems. There is a huge body of literature on socio-cultural and activity theory and I have only scratched its surface. I have taken from it that which resonates with my research data and is useful in its analysis. In selecting theoretical concepts which accord with my own research data, there is little that I have completely rejected, except andragogy (Knowles *et al* 1984); my data show that the processes involved in student learning are remarkably similar to those identified in child development and I therefore reject the idea that learning in adulthood is significantly different from learning in childhood. My theoretical perspective comes from a fusion, a synthesis, of many learning theories and perhaps that is inevitable; Tharp and Gallimore refer to their ideas on teaching as assisted performance as 'an eclectic *pastiche*' (1988, p 69).

Before going any further, I want to quote a Research Fellow in Paediatric Neurology who outlined, in straightforward terms, many of the themes of this chapter and especially what is known about the connection between brain chemistry, emotions and the learning environment:

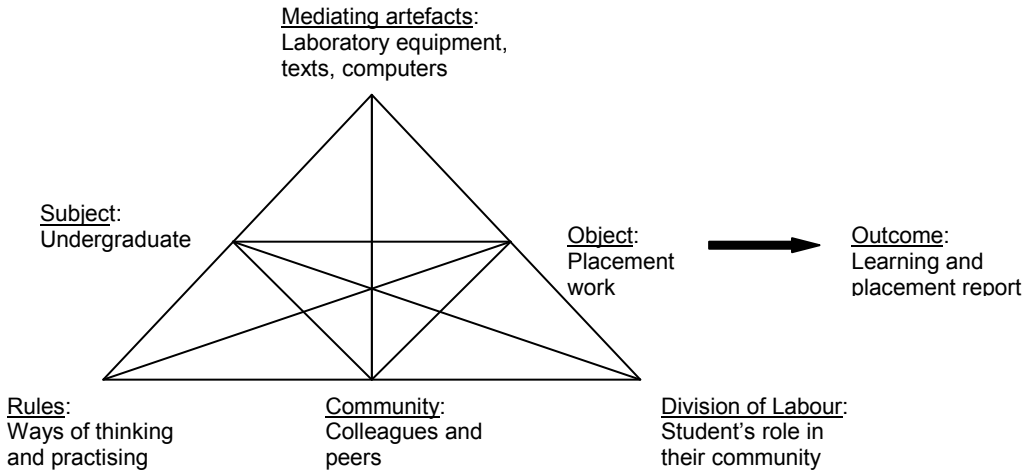
Modern science has now produced enough hard evidence to allow us to start … developing clear pictures as to how and especially why people learn [and] it all comes down to neurochemicals … they can stimulate the necessary processes within the cell to make it grow a brand new connection to another cell … and that is learning. Everything you are, everything you feel and everything you think is because nerve cells in your brain have grown connections to other nerve cells to form a pattern of firing that is hard-wired into you.' He went on to state that **'Threat, violence, terror [i.e. extreme stress, are] very bad at producing the right mix of chemicals … Modern science can tell us that they were actually very good at switching off the conscious mind [but] turn on the right chemistry in the right amounts in the right places and learning will occur.**

… The most powerful way to get any child to learn is to make them feel understood as an individual … in a situation where their self esteem is good and they feel confident, they will feel engaged [and] that is the most powerful aid to learning yet to be identified. Focussed attention in a relaxed but alert individual who feels a sense of reward or expected reward releases a chemical mix in the learning areas of the brain that wire together nerve cells into repeated patterns of firing [that] represent knowledge and the more often a child is exposed to that type of learning environment, the more positive their experience of school will become and the more they will learn.

Paying attention is a neurochemically dependent activity … [it occurs, mainly through dopamine] because the limbic brain has decided that something is worth attending to … hence the need to involve them emotionally first … Find the route into learning by engaging the child's emotions and you will have a happy human who is engaged with you in the learning task' (Curran, 2003/4).

My argument is that the same applies to undergraduates and to all learners. Somehow it pleases me to know that the reason why MCB students' learning is promoted by encouragement, praise and reward, and inhibited by excessive stress, has it roots in the very molecular and cellular biology they are studying.

The model described above represents a constructivist, activity-based socio-cultural view of placement learning. It is different from the conventional models of post-Vygotskian theorists (Engeström et al 1999; Daniels 2001), where culturally-mediated activity theory is modelled using a pyramid or triangle, although it is possible to model placement learning accordingly. Over the page is a second generation socio-cultural and activity (SCAT) diagram (first generation comprises the top half only, see forward):



Why, then, are my models so different? Perhaps it is primarily because traditional post-Vygotskian activity theorists study learning from the perspective of the collective, the organisational, the perspective of activity systems. In contrast, this research project examines student learning from students' perspectives; its focus is individual learners. In terms of the cell-culture analogy discussed earlier, activity theorists such as Engeström are like physiologists examining the workings of a tissue or organ while I am a molecular biologist focussing primarily on the processes within and surrounding individual cells and the activity systems in which students find themselves (placement institutions or university) are considered only in terms of their impact on students. Both views are equally valid and both can be informative about learning situations but the perspective is different.

During the early stages of this project, I preferred to keep in mind the concepts of the model derived from my work with participants, particularly since some of the imagery has its roots in molecular biology and so had greater meaning for MCB students than SCAT diagrams.

At this stage of the research, after reflection on the supplementary studies, a number of analytical categories had emerged from the data. The first was 'Activity' and the second was 'Mediation', whether provided by the student's local or by the wider, cultural environment. There was variation between placements in both of these categories; good placements provided high

quality activity and mediation, mediocre ones were strong in one area and not the other and poor placements were weak in both. Therefore some students had rich opportunities while others were disadvantaged compared to their peers. The third category was 'Learner individuality'; some students have greater potential than others and are likely to benefit more from the opportunities afforded to them. These three categories influence the final analytical category, 'Learning outcomes'; placements resulted in little learning or in a huge amount, involve merely skills acquisition or altered understanding of academic, personal or world views.

Looked at another way, Activity equates with the 'Object' in the conventional diagram of an activity system and Local Mediation with 'Mediating artefacts'. Wider cultural mediation includes the meaning embodied in 'Rules', 'Community' and 'Division of Labour', as they impact on learners, individually and collectively.

The model which was derived with help from research participants led to an amended framework for analysis of placement learning which was quite different from earlier drafts (Appendix 3). The amended framework can be written as shown over the page:

Analytical Framework, based on preliminary research

- Activity (related to object, goal, purpose, intention, motivation):

  Which activity are the students really engaged in, in practice?

- Local and Wider-cultural Mediation (related to emotional support, support for learning, direct and indirect human interactions, language, texts, signs, tools, psychological tools, cultural ethos):

  What support do students receive and what messages are they exposed to?

- Learner Individuality (innate ability, attributes, personality, background, experience, perceptions):

  How do students perceive and react to their learning opportunities?

- Learning Outcomes:

  What is the effect of the factors listed above on students' learning?

* * * * * * * * * * *

Some definitions

It is now time to give some definitions. Many of the terms used above come from the literature on learning and they are rarely unproblematic. Each writer seems to have their own fine-tuned definitions and this is particularly true when a word has been translated into English from, say, Russian. Which term has priority seems to depend on the writer's frame of reference or perspective. In this section I shall try to describe the way that I have come to understand and use these terms in the light of my research data.

Activity

The aim of this research is to gain a better understanding of undergraduate learning at programme level through students' perspectives of their learning opportunities. For this reason, the main Activity is 'Doing a degree'. Within

this category, however, are lesser Activities such as 'Doing placement', doing particular units or modules (involving lectures, practical classes, seminars etc). I shall therefore use the word in a variety of ways. These Activities comprise, at a lower level, a variety of Actions including note-taking, revision, doing experiments, collecting data, data analysis, information sourcing, critical thinking, essay-writing, scientific communication, sitting exams and so on. A higher level of analysis might define the Activity as Higher Education within the University of Bath or from the perspective of Government policy but this was not the purpose of my research.

When I asked myself *'Which activity are students really engaged in, in practice?'* I sought to discover the focus of the student's attention. Is it, for example, their placement work or is it instead avoiding their boss? I struggled to decide whether this was actually their Activity, in socio-cultural terms, or the Object of their activity. This dilemma is resolved in Chapter 7.

Activity is my first analytical category because students told me that their engagement in meaningful Activity, epitomised by an interesting and worthwhile placement project, could drive their learning, give them purpose and motivate them to work and to learn. When placement students saw themselves as members of a team and their work as part of the wider endeavour of their host institution, doing their project accorded with the Marxist idea of Activity which involves collective productivity (see Engeström, Miettinen and Punamäki, 1999). Often, though, students' reports of their placements did not convey any sense of collective endeavour. However, Activity does not occur in isolation; learning is mediated within a particular socio-cultural setting. My analytical framework owes more to Vygotsky, who emphasised the importance of socially meaningful activity, than to Leontiev, who stressed practical material activity while playing down the role of mediation (Kozulin, 1996) or to Engeström and others who study Activity Systems.

Mediation

Relatively few instances of learning are direct, occurring without the mediation provided by cultural artefacts. Mediation is a huge concept. It can be artificially divided into local mediation and wider, cultural mediation. Local mediation concerns the support (emotional support and support for learning) and the messages available from the student's local environment, e.g. from placement colleagues, lectures, tutorials, practical classes, handouts, books, interactions with academic and support staff, the internet. Cultural mediation involves the support and messages to be derived from the culture or ethos of the students' Department, University, placement institution or the English Higher Education system more generally. In fact, there is interrelatedness between these two categories. It should be pointed out that even separating Activity and Mediation is not without difficulty as the nature of their placement Activity conveys meaning to the student about their position in the world; they may be valued team members or the 'Lab Whore', cheap labour, not valued.

Mediators can also be categorised, as Vygotsky did, into material tools, psychological tools and fellow human beings (Kozulin, 1998). Even here, though, I struggle to differentiate convincingly between potential categories. Is an email a tool for conveying meaning to the reader or is it a dialogue between two people? We can distinguish between verbal and non-verbal communication but if someone's face falls on your arrival you understand, just as certainly as if they had spoken, that your visit is not welcome (see forward); the meaning/the message is the same in both cases.

For the moment, at least, I will use Mediation for *anything* from which a student can derive meaning, make sense or gain understanding. Their understanding or learning could concern some aspect of their academic subject, the world or their own role within it. This is historically-based, socio-cultural semiotic mediation. To reiterate, my definition of culture is not that which surrounds (like the layers of an onion), not that which weaves us together, not even a garden (see Cole 1996); I liken culture to interstitial fluid or the artificial 'culture media' in which cells can be grown. We are all

immersed in a cultural milieu of exchanged messages. The influence of culture is diffuse but pervasive. Cultural artefacts (physical and conceptual, see Cole 1996) affect the identity of individuals within that culture in much the same way that signalling molecules in a cell-culture medium can influence cellular differentiation; these messenger molecules have dramatic effects on recipient cells' internal activity and structure, influencing not merely morphology but role and function. They help to determine what a cell becomes. In human terms, socio-cultural mediation dictates not only what is learnt but how understanding comes about and, ultimately, the very identity of the members of the society and their collective culture.

In *Vygotsky and Pedagogy*, Daniels wrote that 'In sociocultural theory the emphasis is on semiotic mediation with a particular emphasis on speech. In activity theory it is the activity itself which takes the centre stage in analysis' (2001, p 1). I would be hard pressed to say which of the two labels best fits these research data. Activity is, it seems, vitally important but only if it has meaning for the student and provides opportunities for the student to engage and to make sense of their experiences; speech is just one of a range of vehicles involved in meaning-making. For this reason, I prefer to use the term Socio-Cultural and Activity theories (SCAT).

Returning briefly to conventional, triangular models of activity theory, the one which accords with my thinking at this stage is the simple, first generation triangle which does not itemise Rules, Community and Division of Labour but may include these categories under the umbrella of Mediation.

Learner Individuality

There are a number of ways to describe (if not define) individuals each, of necessity, imperfect. Every student might be categorised according to their age, gender, ethnicity, educational background, social background and so on. Defining them according to their ability is considerably more problematic since the work of Vygotsky discredited traditional IQ tests and demonstrated that what a learner has achieved in, say, their A-level exams is no indication

of what they may be capable of, with assistance. Psychological profiles could provide further insight into individual students but are beyond the scope of this research.

Instead, Chapter 6 will include descriptive profiles of some students as individuals, using the data they provided on themselves and their learning experiences, and in the analysis in Chapter 7, it is students' self-perceptions which are of most interest. For example, individual students defined themselves variously as Scientists, as 'Average' or as 'Lowly undergraduates'.

Learning Outcomes

Learning Outcomes can be thought of in terms of demonstrable skills acquired, percentages or marks achieved in assessment exercises and degree classifications but are these realistic measures? From a constructivist standpoint, only the student can really know what they have learnt, how their understanding has developed, whether they have internalised their knowledge to any great degree and whether they have changed their identity as a result of their learning experiences. For this reason, I have examined how students themselves described and defined their learning. Their descriptions referred to the acquisition of skills and new ways of thinking, to their development as scientists and as individuals.

In summary then, the framework derived here is a synthesis of a variety of strands within socio-cultural and activity theory: 'Activity' as an analytical category comes from writers like Engeström and, of course, from Vygotsky and Leontiev (but leaves aside, for the time being, its Marxist roots in productive collective endeavour). The category of historically-based socio-cultural semiotic Mediation accords with Vygotsky's work and with contemporary writers like Cole and Wenger. The significance of Learner Individuality was recognised by constructivists like Piaget and significantly extended by the work of Vygotsky, who identified the fact that individuals have differing potentials to learn in social settings, differing Zones of Proximal

Development. In addition, the holistic nature of human learners, as both emotional and logical beings, was recognised by writers such as Dewey and Rogers and, more recently, by neuroscientists like Damasio. My fourth category of Learning Outcomes, as defined by students' own perspectives on their learning, follows logically from a constructivist view of learning and a belief, perhaps shared by Ramsden (whose words I paraphrase), that students are uniquely qualified to know and to articulate on the subject of their own learning (1992, p 89).

Activity, mediation and individuality are immensely powerful concepts and ones which hold sway in the very different learning situations of child development and student placements. It seems that they may be able to explain human learning in general, including undergraduate learning from university-based learning opportunities.

* * * * * * * * * *

My first research question, 'What is the nature of placement learning?', must be answered with 'It depends'. Not only what is learnt on placement but, more particularly, the nature of that learning apparently depends to a high degree on the potential for learning in the placement situation. Sometimes the learning involves merely skills and sometimes it is transformational. Regarding second and third research questions, the initial studies have given an insight into the processes involved in learning from placement experiences but have not yet made direct comparison between placement- and university-based learning.

Chapter 6 will outline data from the main, longitudinal study into undergraduate learning during three and four-year (sandwich), BSc and Masters programmes. Chapter 7 will then test the model and framework, just described, as an analytical tool for understanding undergraduate learning and Chapter 8 will consider the implications of this research.

CHAPTER 6: LONGITUDINAL STUDY DATA

This chapter reports the empirical data derived from a four-year study into the undergraduate experiences of a group of students of Molecular and Cellular Biology at the University of Bath, from entry in 2001 to graduation in 2004 or, in the case of students on the sandwich degree programme, 2005. Student data are presented in year order. The narrative was composed using quotations which I considered to be significant from the huge volume of data generated during prolonged interaction and dialogue with participant students.

At the end of the chapter, there is a brief section on the views of academic staff on learning to teach at the University of Bath. Data of a different type, derived from published material about the Department and University, were used in the analysis which follows in Chapter 7 and is introduced there.

Students were introduced to this project when they first came to university, and invited to participate. Those who did so, especially over four years, demonstrated a major commitment to this research. I am very grateful to them for enabling this project to take place and consider it a great privilege to have worked with them.

A variable group of undergraduates took part in this phase of the study, some from beginning to end, some occasionally, depending on their time constraints and inclination. There were a total of 26 participants (11 males and 15 females, including one mature woman) who took part in meetings (mostly informal) or contributed by email. Seven students were on the undergraduate Masters programme. The maximum number of places available on MCB programmes each year is 30; therefore the participation rate in this research is > 86% overall. A table of participation is given below. Those marked with an asterisk are the subject of individual profiles, given towards the end of this chapter. Where I have typed ‘Email(s)’, the only contacts were through email but where I have written ‘Meeting(s)’ there were often email contacts and sometimes telephone calls as well.

First and second year meetings were focus groups, attended by several students. Final year meetings were less formal and more varied, sometimes involving a small group or pair of students but also one-to-one meetings with individual undergraduates

Group L participants are referenced with L (longitudinal) 1-26, when it was possible to attribute data to individuals. It was not possible to assign to individuals data from a meeting held in Summer 2002, where 10 students were present, most of whom I did not then know. Those present were L1-3 and L10-16. The timings of the individual contributions are given alongside the student reference.

Table of participation in the longitudinal study, 2001-2005

	First Year 2001-2002			Second Year 2002-2003		Placements	Final Year 2003-4 or 2004-5		
Student Ref	**Autumn 01**	**Spring 02**	**Summer 02**	**Spring 03**	**Summer 03**	**2003-2004**	**Autumn**	**Spring**	**Summer**
L1*	Meeting		Meeting	Meeting	Meeting	US, Emails, meeting	Meetings	Meetings	Meetings
L2	Meeting	Email	Meeting			-			Meeting
L3*	Meeting	Meeting	Meeting	Meeting	Meeting	US, Emails	Meetings	Meeting	Meeting
L4	Meeting	Email		Email		UK, Emails		Meeting	Email
L5*	Meeting	Email		Email		UK, Emails	Email		Email
L6	Email					-			
L7	Email			Email		UK			
L8	Email	Email				UK, Emails			
L9*	Email	Email		Meeting	Meeting	UK, Emails	Meeting	Meeting	Meeting
L10	Email	Email	Meeting			-		Meeting	
L11			Meeting	Meeting		UK, Emails	Meeting	Meeting	Meeting
L12			Meeting	Meeting	Meeting	US, Emails	Meetings	Meeting	Meeting
L13			Meeting			?			
L14			Meeting			?			
L15			Meeting	Email		UK	Meeting		
L16*			Meeting	Email	Email	Europe, Emails			
L17						US, Emails	Meeting	Meeting	Meeting
L18						UK, Emails	Meeting	Meeting	Meeting
L19*						US, Emails	Meeting	Meeting	Email
L20*						US, Emails	Meeting	Meeting	
L21						US, Emails			
L22						-	Meeting	Meeting	Meeting
L23						-	Meeting	Meeting	Meeting
L24						-	Meeting		Meeting
L25*						-	Meeting	Meeting	Email
L26						UK	Email		

The volume of data resulting from regular contacts over four years is inevitably huge and, in producing this narrative, the data had to be used selectively. When making the selection, I included both positive and negative comments, both criticisms and constructive suggestions on how undergraduates' experiences might be enhanced; unfortunately, students were more vociferous with their criticisms than with their praise and this has given a somewhat negative overall impression, despite the fact that students thought MCB programmes at Bath were good (see forward). Majority views are, of course, represented but so too are deviant cases. Both are informative. The consensus view may reveal more about the learning situation itself, while an unusual opinion may be indicative of an individual's perception of that situation. Above all I have chosen certain quotations over others for the contribution they make towards what I hope and believe is a balanced and accurate account of students' perceptions of their learning experiences.

Students' words are rich and fascinating and I feel that their story could and should be told succinctly. However, I am also aware that there will be sceptics who require "evidence" that the narrative is truly representative (see Chapter 8). This chapter is, therefore, longer than I would have liked. In addition, I decided to devote this chapter to data alone and have left analysis and interpretation until later. There are two reasons for this; the first is in order to allow readers to draw their own conclusions on the data before reading my analysis and the second is to facilitate the sharing of data with any interested colleagues who may wish to use my data in different ways and from different standpoints (theoretical or practical).

With regards to 'my' data, it is my belief that these data belong not to me but to the participants who contributed them so generously and, since students wanted their voice to be heard (that is my conviction), I am happy that this rich resource be used by others. Certainly it would feel good if my input was acknowledged but the data and their inherent meanings are of far more value than my own prestige and the fact that other researchers may interpret them differently can only enrich our understandings.

Data from the first and second years of undergraduate experience

There were five group meetings with undergraduates in the longitudinal study during their first two years and some students who did not attend replied to emails. Initial email questionnaires are given in Appendix 2.3 and 2.4; the same questions formed the basis of group meetings. After this, questioning formed part of a more open dialogue, enabling students' own agenda to emerge naturally; questions are given in the main text where appropriate. Initial contacts enabled me to start building rapport with participants and to find out their perceptions of the early stages of the degree programme. They also enabled me to observe changes which took place in student learning and personal perspectives over time. Other participants commented on first and second year experiences later in the study, some after graduation. As mentioned earlier, constructive feedback and specific criticisms were provided to the Department of Biology & Biochemistry (e.g. emails to the Director of Teaching in February, July and October 2003, March 2004, Director of Placement, June 2003); on several occasions students specifically asked that I should provide departmental feedback, preferring the anonymity which this afforded them. In addition, some student data and evidence-based suggestions have been provided to the pro-Vice Chancellor, Learning and Teaching (emails 2004).

First year data

Little mention was made of home-sickness and most students said they felt settled within a month of coming to university. The mature student was an exception to this; despite having attended university and graduated when younger she said 'It feels probably worse this time because I do feel a little bit isolated and it's difficult because you feel like you don't quite fit in' (L1, Autumn 2001). One student, who had spent a year working before coming to university, said 'It was a bit of a shock to go back to study and it took me about a year to get back into it' (L24, Summer 2004).

On lectures

Many students commented on the lack of interaction and lack of dialogue with staff during lectures and compared university unfavourably with school:

- 'The big difference is that I don't have any input as I would in class; there is no discussion' (L9, Autumn 2001).
- 'It's one of the hard things of coming to university. At A-levels your hand's held in a small class with one teacher whereas now you've just got one lecturer between hundreds so there's no interaction, there's no motivation … They're just telling you the information and what you do with it is up to you' (Summer 2002).
- 'Some of them do say "Ask questions" but, when you're in a lecture with 150 people, you don't stick your hand up and ask' (L1, Summer 2002).

Many students mentioned the variable quality of lectures and when I asked '*Do you think the teaching staff are good at motivating you to do the best you can?*' there was a collective titter and 'Some are clearly bored' (L1, Summer 2002). When asked how the situation could be improved, 'The only way … would be to be enthusiastic themselves' (Summer 2002). A good lecturer was described as 'Very organised and writes key points on the board and gives us references' (L3, Autumn 2001). Lack of organisation and communication between staff was also criticised 'Physiology … lecturer changes every other lecture and they are all from different departments and I don't think any of them actually bothered communicating with the others!' (L8, Spring 2002).

Some undergraduates seem to have struggled initially with the pace of lectures, with the volume of information covered and with their note taking:

- 'Sometimes lecturers go too fast and students get big gaps in their notes' (L3, Autumn 2001). In the Spring this student complained of having to take extensive notes because the lecturer gave no 'Follow up or references … and I don't really enjoy that. I just wanted key points but I

thought if I didn't write everything down I might miss something', and 'Every time I looked at the slide, to think about it, he went on to the next one. It was very annoying. He needs to plan his lectures a bit more' (L3, Spring 2002).

- 'He just doesn't stop talking, he just goes on and on' (Summer 2002).
- 'I find that I am writing all the time [and therefore] cannot take in what the lecturer is saying' (L10, Autumn 2001). This was echoed later, referring to being given handouts or notes on the web, 'I found this very beneficial as I was able to just sit and listen and take in what the lecturer was saying' (L10, Spring 2002).
- 'Some give lots of handouts … which is good but, at the same time, bad because you're not really paying attention, because it's all there' (L5, Autumn 2001).
- 'I find I learn more if I'm writing lots of notes' (L2, Autumn 2001).
- 'Being given handouts of diagrams only and having to make your own notes around them works best for me' (L8, Autumn 2001).

Generally undergraduates had not been taught study skills: 'We weren't taught any of it, we were straight into it' (L24, Summer 2004), although L3 had been taught and thought it 'Would have been good' at university (Spring 2002) and L22 had been exposed to different lecture styles at school so 'Wasn't quite so daunted … knew what to expect' (Summer 2004).

Several subjects were mentioned individually. None was universally praised but several were widely criticised. For example, Organic Chemistry was criticised by Group L participants as it had been by 1998 graduates: 'I struggle to stay awake' (L10, Autumn 2001) and 'Something like Organic Chemistry, I just found that, even though I understood it, it was just parrot-fashion learning … really boring' (Summer 2002). Reflection, after graduation, confirmed this view of Organic Chemistry as 'A-level duplication … no noticeable use for the rest of the course and therefore a waste of time … served as [an] assault on personal confidence … as I didn't do at all well

in the exam, helping to create a rather negative mindset, which I retained for the following 2 years!' (L25, Summer 2004).

Introduction to Enzymology was criticised for covering 'Everything there was to know on enzymology, with like 60 slides'. The lecturer did not like being asked to slow down and did not reduce his pace (e.g. L12, Spring 2005).

In some instances, undergraduates failed to see the relevance of a subject to their degree programme, e.g. Biodiversity was seen as 'Not really pertinent to molecular biology … more one for [organismal] biologists' (L25, Summer 2004).

Statistics was criticised by many: [It] 'could be improved simply by being organised by someone who understands stats themselves and that booklet that was "essential to buy" is rubbish!' (L8, Spring 2002). 'I thought that was awful' and, from another student, 'I actually managed to carry out all the tests but the answers, I hadn't a *clue* what they meant' (Summer 2002), while a final year student said 'If you put Minitab [statistics package] in front of me now I wouldn't know where to start' (L24, Autumn 2003).

Remedial Maths classes were described as 'Horrific' and 'A complete waste of time' and another student expanded by saying that 'Stuff I understood at GCSE, and remembered, I went into the maths class and came out totally confused' (Summer 2002). Even after graduation, Remedial Maths was described by a third participant as 'Pointless' (L23, Summer 2004). One placement student 'Struggled with maths in uni [where] questions were not based on maths you need in the lab, e.g. calculating concentrations' but found it easier on placement (L18, November 2003). One final year student said, with heavy sarcasm, that 'Remedial is a lovely word' and explained that 'The lecturing was not great because it was somebody of a maths orientation lecturing to people who aren't mathematically orientated so that was no good at all' (L25, Autumn 2003). Being forced to do Remedial Maths in the first year still rankled after graduation 'Total waste of time … any maths you need, you can learn when you're doing the actual unit (I had to learn some for my

research project for example) … the taught [maths] was of no relevance … if they insist on teaching [it] then use staff who are actually capable of teaching it, not somebody who will just whiz through it all and assume we understand it, thus entirely missing the point of why the classes are being held!' (L25, Summer 2004).

On tutorials

First year students usually met their tutors fortnightly. Most students liked their tutors and felt they could go to them. As with lectures, the quality seemed to be variable. One student said that tutorial essays were very helpful to his learning because they were 'Tied in with some of the lectures and it forced me to read different chapters [of the textbook] and I just got absorbed in it' (L3, Spring 2002). Others said that tutorials sometimes 'Feel a bit pointless' (L9, Spring 2002), that 'Work set doesn't seem to fit in with any aspect of the rest of the course' (L4, Spring 2002) or that 'My tutor tends to talk at us rather than with us' (L8, Spring 2002).

After graduation, one participant thought there should be 'Tighter rules … less up to the discretion of tutors … large discrepancy in the amount of work people had to do' (L25, Summer 2004).

On practical classes

Many students found first year practicals very stressful and one gave the example of an Animal Physiology practical where his 'Resting heart rate was about 85 or 90, as opposed to about 65 normally' which he attributed to stress (L25, Autumn 2003). Other comments included 'Feel like I don't know what the hell I'm doing and have often felt rushed' (L2, Spring 2002). Class numbers were 'A bit of a shock … feel a bit pressurized … panic … it's like a race, the minute we start everyone's charging about' (L1, Autumn 2001). 'I don't like [practicals] as much as I used to [at school] because before there was a lot more space, a lot more time … and it wasn't a rush' and pupils had

a better sense of what they should do because they could ask (L4, Autumn 2001).

Students sometimes felt ill-prepared for their practical classes:

- 'We're just given a booklet and have to read it and do it straight away … I couldn't prepare. And then I prepared for the next practical by reading [ahead] but they skipped that [section] and went on to the next … in a muddle all the way through.' The same student wanted to understand 'beforehand but sometimes … I have to say "Well, I'll do the experiment, I'll do what they say and look it up afterwards" but end up not doing it because I've got to write it up' (L3, Spring 2002).
- [It's] 'annoying. It's like "Here is a sheet. Go and do it."' (L8, Autumn 2001).

It was 'Very weird being told what to do over a microphone … some of the [postgraduate student] demonstrators are awful, one person couldn't show us how to use a pipette' (L9, Autumn 2001). I should point out that 'demonstrators' is a misnomer as they rarely demonstrate a technique or an experiment; as L3 put it, they are there to ask 'If you need help or [are] completely confused' (February 2005). Some demonstrators are 'Just patronising' (L22, Autumn 2003) and set out to impress first year students with their superior knowledge, rather than to help them (Summer 2002). 'You're scared to ask them anything' (L23, Autumn 2003).

Unlike the 1998 graduates, Group L did not admit to inventing results but to 'Fudge' (L12, Spring 2003), 'Some results are modulated somewhat' (L25, Autumn 2003) and 'That goes without saying, especially in your first year' (L24, Autumn 2003). After graduation, one of these students advised that 'Convenors should not … cram too much into a lab session - we don't learn any more by having to rush through lots of exercises, we just get stressed and resent having to do them!' (L25, Summer 2004).

In addition, practical classes took some flak for the lateness of feedback from practical write-ups.

- 'We didn't get them back until we'd done our exams … until we'd finished the module, so that wasn't any use at all' (Summer 2002).
- 'I'd written up four [practicals] and then you realised what you were doing wrong, after you'd written them all up' (Summer 2002).
- 'We haven't really had much feedback at all.' This student mentioned having laboratory written work returned 'With no comments on at all, so I had no idea whether I was doing right or not' (Summer 2002).

There were some favourable comments:

- 'It's one thing if you're … doing ecology - you can imagine what a field looks like, but if you're doing it all at molecular level it is just nice to do practicals and put some techniques into practice' (L12, Summer 2002).
- 'Practicals are the best part of my week … best thing for me to learn as I always learn more from hands on work … a fun way to learn' (L5, Spring 2002).

<u>On exams</u>

First year undergraduates 'Had no idea of what was expected of us. There are past exam papers but no model answers so we don't know if our practice answers are what we should be revising' (L4 and L9, Spring 2002).

<u>On feedback from students</u>

On the method of collecting student feedback on lectures and practical classes (unit evaluation): 'They only had boxes so you couldn't really write much. You had to write it on the back, and they only gave the sheets right at the end … and that wasn't a good time because everybody rushed them because they wanted to go' (L3, Spring 2002).

On group identity

At the end of their first year a group of ten MCB students felt they had no group identity. 'The only people I know are like my tutor group'. Students of MCB share lectures and practical classes with students studying Biology or Biochemistry; 'I don't know who's a biochemist, who's MCB' (Summer 2002).

Second year data

Participants seemed more relaxed than before in each other's company and mine but more stressed about university. Matters contributing to stress included living off campus, which was 'A big change' (L3, Spring 2003) and 'Bit of a shock' (L9, Spring 2003). Some students spent 'Two hours every day travelling … then wondering why you can't do as much work' (L9, Spring 2003). They felt the timetable forced them to waste time because sometimes they had 'Lots of little breaks' (L12, Spring 2003) and, when home was off campus, 'You can't really nip back home' to work (L3, Spring 2003).

Students felt there was a 'Big jump in workload' (L9, Spring 2003):

- 'It's stress [when] the priority is either finish your coursework before the deadline or do some background reading. You'll always do the coursework' (L3, Summer 2003).
- 'It seems to me that they conspire to stop you reading up on lectures; there's so much else to do' (L1, Summer 2003).

Several students commented that a lot was 'Crammed in before Easter' and 'All the deadlines came at once' (L12 and L9, Summer 2003). [MCB students share units with Masters of Biochemistry students who begin placements at Easter.] 'When I came to revise some of the stuff that was taught before Easter, I couldn't actually remember very much at all.' (L12, Summer 2003). Students said they felt tired and one wrote, 'Really exhausting! … We were literally running from one practical to the next and to the next lecture … I

really needed all the four weeks over Easter to recover from this stress!' (L16, Summer 2003). In addition, working days were sometimes longer with late lectures: 'At the end of an eight-hour practical … the last thing you want is to go to a lecture' (L1, Summer 2003); this comment came from the mature student, accustomed to working long hours.

For placement students, the administration surrounding placements added to their stress, with job interviews and visits to the American Embassy coming in the middle of exams. 'It takes quite a bit of organising' (L12, Summer 2003).

<u>On lectures</u>

Second year students had adapted to lectures and evolved their note-taking techniques. They were 'In slightly smaller groups … feel less isolated … some of the lecturers probably recognise you and it feels a bit more friendly … more interaction. Lecturers are actually doing more what they actually research in … more enthusiastic' (L9, Summer 2003).

There was further mention of work overload, though. In some subjects (e.g. Genes and Development) students were expected to 'Read loads and loads of papers for each lecture and we got three lectures each week … when it came to exams … it's either learning a little bit of everything or just learning a few topics really, really well' (L9, Spring 2003).

Use of PowerPoint presentations (or their *mis*-use) was blamed for some of the overload:

- 'He just gave you pages of PowerPoint slides … he doesn't keep my attention, just reading through. When you've got an hours worth … you've got an awful lot by the end … I did about a third of it, cut two thirds out because I just couldn't learn it all … It just keeps your attention so much longer if somebody's actually speaking to you rather than reading … it's their own words. You can concentrate more' (L9, Summer 2003).

- ‘Reading off PowerPoint or overheads, it’s basically like adding the lecturer’s notes to the student’s notes without passing through the brain of either … The best ones are when they just have key points and then you really have to listen’ (L3, Spring 2003).

Students were concerned about inequality between lecture courses with some (like Statistics) seen as ‘A bit of a doss course really … he makes it very easy to get good marks’ (L9, Spring 2003) while the consensus was that Genes and Development was very hard (Spring 2003). They had a sense of injustice:

- ‘Your average mark seems to depend more on what you chose, rather than how good you were, how intelligent you are’ (L9, Spring 2003).
- ‘And we knew in advance that Statistics was supposed to be a cushy number as well, like a doss, but I’ve got no interest in them’. I believe this student felt penalised for choosing Genes and Development that held genuine interest for her (L1, Spring 2003).

<u>On tutorials</u>

Many tutorials were taken by postdoctoral students, rather than tutors. Comments on tutorial work included ‘We seem to have a lot of tutorial work … and it seems that not everyone gets the same amount … We had to do a presentation for our tutor and we just got a mark, he emailed us a mark. I couldn’t believe it … we didn’t get any feedback on our other presentation either … if I had got a low mark, what use would that have been?’ (L1, Summer 2003).

Another student said ‘There’s a lot of variation between them’ and that essays were always on a subject of interest to her tutor but of no interest to her (L9, Summer 2003) but another participant was ‘Quite impressed with the way my tutor has been … he asks us what other essays we’ve got and what work we’ve got and adjusts [tutorial work for] when we have time. He even let us change our essay title if we didn’t think it was good enough … that was

very good. Then we went out for a drink with him yesterday, about eight of us. He really seems to care what we do, how our work's going' (L3, Summer 2003).

On practical classes

One student wrote that second year practicals 'Managed to be both tedious and stressful at the same time' and that 'Updating the [handbook] sometime in the last 20 years might have helped too' (L7, Spring 2003), another participant found practical classes unmemorable and blushed (shame? embarrassment?) because he had quickly forgotten the reason for using differential culture media (L12, Summer 2003). A different student said that university practicals didn't allow any independent thought; they were a race to finish and not about learning (L20, October 2004).

Others thought the atmosphere in their practical classes was generally more relaxed, 'More laid back, take your time and do it as well as you can' (L9, Spring 2003). Students praised Practical Molecular Biology and said that it built on theory they had learnt earlier. Students worked in pairs and afterwards each completed a practical work book before the pair was interviewed about their understanding of the work. The book and interview formed the only assessment, there was no exam. Interviewers enquired about the practical classes in terms of '"What does this mean? What happens here? Why? Why did you use these controls?" … and talked it through to make sure you understood it. [This] really drummed it in, because you'd done it in practice, then you'd had to think really hard about it for the write-up, then you'd had to do the interview … quite a number of times you'd had to look over it' (L9 and L12) and 'When you leave you really do understand it' (L3). There was, however, criticism of a small part of this practical course which was based on a computer programme 'Nobody had a clue what they were doing' (L1,) and 'That was the one really bad thing' (L9) (Summer 2003).

Plant Micro-organism practicals were also praised: 'They were really helpful. The lecturers stood at the front and said "I want you to learn, so if there's anything you can't do I'll come and show you how to do it. It's not a test of whether you can do it but I'm going to try to teach you"' (L22, Autumn 2003).

Practical write-ups were seen as very time-consuming, but this was more a statement than a criticism, although it added to students' workload. 'They say you're only supposed to take a day or two on your write-ups but it takes far longer than that' (L1). 'It only felt like you were doing a question an hour, it was like really slow going, it was never ending' (L9) (Summer 2003).

There were further complaints about long delays between handing in a piece of practical work and getting it back (L3) and, although some demonstrators were good, many were again criticised as being 'Hopeless' (L9) (Summer 2003); they sometimes 'Mark according to whether they like someone' and one demonstrator got his girlfriend to do his marking (L22, Autumn 2003).

At the end of their second year, despite many practical classes, these students did not know how to keep a lab book (L1, L9, L12 Summer 2003) and, as placement students reported, were not familiar with many other basics of MCB laboratory work:

- 'There needs to be a compulsory module just covering molecular techniques … I realise we wouldn't have been able to cover every [one] in detail but things like PCR - I have heard of it, I knew what it does but I didn't have the first clue about how to [set] one up. Uni practical classes are pretty useless for this - you simply follow the handbook, not knowing why you are doing anything, then the following week you get your plates back but technicians have been doing stuff to them and it's really hard to follow what the hell you're doing' (L8, October 2003).
- L3 suggested that 'Before [students were] given a protocol, they have to think about how to do it and why … making everything themselves might also be useful … my [placement] lab book is full of procedures and steps for calculating concentrations, splitting cell lines, transfections etc.

Something like this, learnt in second year, would be a great advantage' (July 2003).

- 'I find it very hard to do dilutions, work out the volumes of enzymes and buffers' and 'Most of the things I am doing now I have never done before or done once. I just feel completely useless' (L19, August and September 2003).

On exams

Students seemed happier once they had a better idea of what was expected of them and some thought exam questions more challenging in the second year:

- 'This year was a lot more on testing the understanding and relating what you know into essay form, which drags all aspects together' (L5, Spring 2003).
- 'More difficult than last year because not only simple knowledge … also had to "construct" our answer, rather than simply regurgitate' (L16, Spring 2003).
- [Lecturers] 'like you to integrate things so they put a few topics into one question' (L9, Spring 2003).

Some, though, thought 'Everything we have done so far is learning and regurgitating in exams' (L1, July 2004) and 'Exams are more a test of how much you can write in a certain amount of time than they are of your ability' (L25, Autumn 2003). After graduation, this participant thought that it would be better if second year exams were two hours long, to familiarise students with the format of final exams and to avoid 'The ridiculous situation … where you have an hour to cram down as much as you [can] ... a race for who can write the quickest, rather than who is more knowledgeable' (L25, Summer 2004).

Lack of feedback was still a major concern. For example, 'Still no feedback really. I didn't do as well as I would have liked in exams and would like to

know why' (L4, Spring 2003) and 'If you've done badly, tough!' (L22, Autumn 2003). The method of ascertaining exam results, by looking at a notice board, was unpopular. Students search for their examination number amongst rows of small type: 'It's so horrible, having to go and look at that board' (L1, Spring 2003). Biology & Biochemistry was compared unfavourably with other departments, where students were given their results individually by their tutors and were able to discuss them. If, for some reason, the tutor system cannot be used, some students would prefer to receive their results only by letter.

Before placements

Students with UK placement institutions had visited them before going on placement, had met other students with whom they would be working and were arranging shared accommodation: 'Takes the tension away when you know who you're living with and working with' (L9, Summer 2003).

One student who was going abroad had been 'Talking to [emailing] a few people in my supervisor's lab. I got to know quite a few people out there' (L3, Summer 2003). Another, who was going to a different lab in the same institution, had had no response to his emails, and knew nothing of the project or the lab, other than through some of their publications (L20, October 2004).

Reasons for wanting to do a placement varied:

- It is a requirement of the Masters course. 'Otherwise I wouldn't have done one because I've got enough work experience!' (Mature student, L1).
- 'A year to try different things and find out what you do or don't want to do afterwards' (L9).
- 'An ideal opportunity to really get to know what it's like working … practically in the lab'. This student thought fourth year students were a

good advertisement for placements because 'They learnt so much more' (L3).

- 'It is part of your degree because it's putting into practice things you've learnt … should tie it all together … If you do a placement it looks good on your CV. If you want to go into research it does look better … it shows you have references.' This student expected his placement to be 'Like work' (L12) (Spring 2003).

Data from placements

Sixteen students in the longitudinal study (4 males, 12 females including one mature student) provided placement data by email during their placements and/or through meetings and emails afterwards. Eight placements were in the United Kingdom, one was in Europe and seven in the United States.

A table of placements undertaken in 2003-2004 follows over the page. As above, those in bold type with an asterisk are the subject of individual profiles; more details of their placement experiences are included there (see forward).

Table of placements undertaken in 2003/4

Ref	Host institution	Type of work	Negative comments	Positive comments
L1*	University, US	Research project	Initially bored, frustrated, lacking purpose, stressed when learning nothing. Very lonely much of the time.	On her project - 'I have a goal … quite motivated. Enjoying the work very much, what fun when things work!!' Liked her colleagues.
L3*	University, US	Research projects	Very briefly bored and homesick around his 21st birthday.	'Welcoming atmosphere … everyone is very interested in what everyone else is doing. Really enjoying working here' - despite working long hours. 'Great progress with projects - big achievement … beer at work'. L3 is primary author of two scientific papers.
L4	Agrochemical company, UK	Low key research projects	'I'm mostly just helping anyone who needs an extra pair of hands … feel less valuable'. 'I don't know whether I wish to work as a lab researcher as a long term career'.	Enjoyed 'meaningful projects … increased my self-confidence of working in a lab … meetings and lectures which are of benefit to me. I have to present results [which has made me] more confident - before I hated speaking in front of people and used to go bright red.' 'I know a little more … in specific areas'.
L5*	Research Institute, UK	Low key research projects	Work was repetitive. 'Missing uni friends terribly'.	'Work is very hands on which is great.' 'Glad for the placement year in order for me to do some maturing.
L8	Pharmaceutical company, UK	Research projects	Local area was 'pretty grim social-wise … get very down'.	Learnt by mimicking supervisor. 'I love working in the lab … I probably think differently about a reaction [now] … about what's actually going on', rather than picturing the text book.

Continued - Table of placements undertaken 2003/4

Ref	Host institution	Type of work	Negative comments	Positive comments
L9*	Biotechnology company, UK	Project	None.	Good induction. 'Really nice company to work for and everyone here seems very happy'. L9 was quickly independent. 'Good atmosphere makes you motivated to work.' Good social life. 'Since doing placement I feel more mature, disciplined and efficient.'
L11	Biomedical company, UK	Routine production and quality control	'Disorganised' supervision, extremely routine work 'pretty dull! I haven't felt at all challenged … bored. There are a lot of people opposed to any kind of changes, i.e. the whole point of my work!!' L11 would have liked a research placement. 'I wouldn't want another student to feel as frustrated as I have.'	'More confident in my [lab] ability. Learnt more about how to deal with people than I have any real science'. Things improved a little bit with the appointment of a Production Specialist 'from a research background, so I feel I have found an ally'.
L12	Children's hospital, US	Research projects	Initially bored. Homesick and short of friends some of the time. 'Some people say America's not all that different [but] they're wrong.'	Two projects, the second very 'interesting and … motivated me to learn about what I was actually doing.' Liked his boss's open door policy. 'Overall really worthwhile'.
L15	Clinical research company	Routine analysis	Work boring and repetitive. L15 learnt 'Nothing new except machine work which I wouldn't ever use again, not even how to make a buffer, not even basic scientific techniques.' Used students as cheap labour. Some supervisors sly and backstabbing.	Some people in the company were really great, good friends. Now much wiser about human behaviour after this year.

Continued - Table of placements undertaken 2003/4

Ref	Host institution	Type of work	Negative comments	Positive comments
L16*	Research institute, Europe	Repetitive research	'Not very satisfied. Almost exclusively doing one automated method … no supervision'. In addition, L16 had unsympathetic colleagues. 'I would not recommend this institute to another student'.	Initially happy and pleased with lab success. Learnt accuracy and to think more critically: 'Is this statement right? Was the experiment correct?'
L17	Medical school, US	Routine research project	'Don't enjoy work but can tolerate it … very mundane. I haven't really learnt anything … just one method I now know … same thing all day every day. I have no motivation to learn anything more about it … You just think "what's the point"'. Big disappointments were no molecular work and few people in the lab. 'Been put off doing a PhD and might not have been had I enjoyed my work here … I probably won't love any job I have.'	'Really great boss. He has time for me and is a great mentor.' Made friends and travelled 'New York. It was fantastic, was in Time Square New Year's Eve' and 'Kennedy Space Center - best place ever!' America is so amazing I never want to leave … I want to come back over … get a biology job.
L18	Pharmaceutical company, UK	Research project	None.	Relaxed atmosphere, learnt from previous placement student 'easy to approach'. 'It's surprising how much you learn in that [placement] year.
L19*	Research institute, US	Research project	Briefly not very happy and worried about being able to cope … 'I just feel completely useless, inadequate'.	'Have learnt so, so much since I have been here … through working with truly talented and intelligent people who explain things in depth and detail.' Rich and varied social life. Colleagues … 'almost like having a second family! Fantastic learning experience'.

Continued - Table of placements undertaken 2003/4

Ref	Host institution	Type of work	Negative comments	Positive comments
L20*	University, US	Research project	Later, the supervisor changed from supportive to hyper-critical, 'bullying and harassment', even 'hysterical'. Very long working hours that 'concerned' his roommate. Two minor accidents. Parents worried. Eventually appealed for university help - delayed response.	The lab was 'One of the best of its kind' and, initially, the supervisor was very friendly; working there was 'Very enriching and educational'. L20 got a real buzz out of being immersed in science and was full of ideas, felt creative.
L21	Children's hospital, US	Research project	'Bioinformatics isn't all that interesting so I'm finding it quite hard to understand and retain any information'.	This student liked America and the people she was with. Good social life. 'Doing presentations really helps … forces me to do background reading so I fully understand what I'm doing and can explain it.'
L26	Clinical research company	Routine analysis	As L15 plus 'No-one in the company took our project seriously. They were not interested with anything to do with our degree'.	None.

Eight students in the longitudinal study (**L***) are profiled in more detail later in this chapter. As in the supplementary studies, placement students in 2003/4 experienced some disorientation in unfamiliar surroundings, especially when working abroad: 'Some people say America's not all that different [but] they're wrong' (L12), 'Initially confusing' (L20) and 'I just feel completely useless, inadequate' (L19). It was not uncommon for students to feel homesick and lonely, usually briefly. Also in line with previous studies, those with routine work found it 'Pretty dull' (L11), 'No motivation to learn anything more about it' and 'Put off doing a PhD and might not have been had I enjoyed my work' (L17), while those with a worthwhile project had 'A goal [felt] quite motivated … what fun when things work!!' (L1). Students with experience of both routine and challenging work were clear that they 'Enjoyed meaningful projects' (L4), 'Interesting … motivated me to learn about what I was actually doing (L12).

Some students again reported a lack of or 'disorganised' supervision (L16 and L11) while others had good supervision: 'He has time for me and is a great mentor' (L17). Some experienced good working atmospheres: 'Nice company to work for and everyone here seems very happy' (L9) and 'Welcoming atmosphere … everyone is very interested in what everyone else is doing' (L3) while others suffered 'Bullying and harassment' (L20), had unsympathetic colleagues (L16) or workmates who were 'Opposed to any kind of changes, i.e. the whole point of my work!!' (L11). Some students were 'Not satisfied' (L16) with their placements or had 'Big disappointments' (L17), while others found theirs a 'Fantastic learning experience' (L19).

Interestingly, several students invited my advice, comments or understanding of their situation. E.g. 'I'd be interested to hear what you think … is it common from placement students to feel like this or am I an exception?' (L11, August 2004) and 'It's nice to be able to talk to someone who has been there and knows what it is like, and to be reassured!' (L19, October 2004). 'I do think people like to have a good sound off and air their views on something they have been through like this. You provide a good outlet' and 'A really good resource' for students (L1, August and September 2004). I

was asked for advice on a range of matters including placement report-writing (L19, June 2004), on how to help an over-stressed peer (e.g. 'Do you have any advice on what can be done? (L3 ref L20, March 2004), and on placement posters (L1, September and L3, October 2004). On each occasion I suggested that students should also contact the Biology & Biochemistry Department.

Distance Learning for the Masters Programme

In addition to their placements, Masters students have university-set work, consisting of distance learning problems and five set books to read, in their third year.

In January 2004, L1 wrote 'I actually like the problems because they make me think and reason', but found them distracting when she had a lot of background reading for her placement project, and L19 wrote 'It's nice to have these things to keep my mind thinking about all aspects of science and not just what I'm doing at work'. L20 thought the Masters work worthwhile but, because of a phase of excessively long working hours, found it stressful to find the time for it (October 2004).

L3 summarised the distance learning for the Masters programme as: 'Problems worthwhile, varied, challenging (but of course no feedback. [The Director of Teaching] told me in the SSLC meeting that he forgot to send any feedback at all). Every book an interesting read' (February 2005).

Final year data

Eighteen students took part in this phase of the longitudinal study. Five of them did not do placement (3 males, 2 females) and had their final year in 2003-2004. Thirteen of them (4 males, 9 females including one mature woman) had their final year in 2004-2005, having spent their third year on placement. My contact with them was through email or, more often, informal

meetings between myself and small groups or pairs of students or with individuals.

Post-placement matters

Posters

Students present posters of their placement work early in their final year. L1 telephoned me in a 'Slight panic' about preparing her poster because she thought that other students were spending £40-£70 on having their posters professionally laminated (October 2004); I said I thought scientific content and its clear presentation were more important than a glossy finish but, when they were judged, only those MCB posters which were laminated won prizes. L1 and L19 thought that 'Funny'. They also thought it would have been helpful to them if previously successful posters had been available to them as a guide, but they were no longer on display (October 2004). L3 and L20 were 'Slightly disappointed' that only glossy, laminated posters won prizes (February 2005).

Departmental contact during placement

L1 was surprised that the Department did not check with her before sending another student to the same laboratory: 'Do Bath care what the placement is like or do they have so many students to place they just want as many options as possible?' She also felt that they should contact students to ask how they are getting on while on placement (March and July 2004).

When asked 'Did you get the feeling that the Department really understood how you had got on, on placement?' L3 wrote 'Nobody could visit and nobody asked how it was going (except you). Not even [my] tutor' (February 2005). Students on placement abroad are rarely visited - it would be too expensive.

Several students (e.g. L4, L11) said they received little or no support from the placement team while on placement and L19 said 'There was more from you'. L11 had a caring and sympathetic tutor who did keep in touch during her placement. Some students felt that half fees for placement year were 'Not worth it' (L4, L9, L11, Spring 2005).

L1 had received her post-placement viva by March 2005 and her tutor said that her report was 'Fairly well written'. She felt that she learnt a great deal during her placement year but that her final mark for placement may not reflect this. Neither L3 nor L4 had received a placement report viva five months after handing them in (March 2005).

Critical Reading exam

Students on the undergraduate Masters programme had a Critical Reading exam, in October 2004, based on the required reading during placement. Five of the six Masters students contributed data on this. L3 and L20 understood the book (by Kuhn on paradigms) on which questions were set; L3 was happy with the exam but L20 thought 'Critical Reading' was a misnomer as it was more about regurgitation and that 'The marking criteria followed in this exam did not correspond to the supposed aims of this learning exercise' (Spring 2005). Others struggled:

- 'I know I have failed … The whole exam was on the one book I didn't read because I found it so hard and not related to our degree. I read all the others several times … assumed the exam would be on at least two books' (L17, October 2004).
- L1 and L19 had both assumed questions would be based on two books. In fact, they were on one book which they found very difficult to read and not science-related. L1 wrote 'The exam was awful. He asked questions on the most boring book and I didn't understand them' and said 'I hate waffling but that's what I had to do'. L19 said that she had cried after the exam and never had before (October 2004).

Stress and workload

At the beginning of their final year, some students seemed particularly stressed. One non-placement student described herself as a 'worrier' and, during a 45-minute interview, referred four times to stress and nine times to panic. 'I haven't got time to breathe. I haven't got time to go to the dentist. I feel like I've got too much to do'. It seems that the large number of assessment tasks set at the beginning of the semester may have contributed to this student's sense of panic: 'In the first three days … I was set nine tasks and that was just scary'. In addition, she was anxious about the nature of those tasks, including presentations, fortnightly exams on Data Interpretation and laboratory projects (see forward) (L22, Autumn 2003).

As an aside, it sometimes worried me that, even though participants volunteered to take part in my research, doing so might be adding to their stress levels. I was, therefore, relieved when L22 ended the interview by saying 'Just for a moment I forgot about all the stress' and when another student who had suffered stress later thanked me for 'This cathartic experience' adding 'You've definitely helped ease the passage through this (final) year' (L25, Summer 2004).

Stress was not confined to non-placement students. Despite being 'Eager to get back into the swing of things' (L19, September 2004), stress levels quickly rose for post-placement students too:

- 'It was hard to cope, anxiety mostly … I am OK if I have one thing to concentrate on but, if there's more [I don't] know where to start! Horrible feeling knowing that you have so much to do!' and 'Extremely stressful beginning of January for coursework!' (L3 January 2005).
- 'A bit snowed under' and 'It's taken me quite a while to reacclimatise' to lectures, etc. and 'Much more pressurised and stressful than I thought it was going to be … a little overwhelming at times' (L12, November 2004 and January 2005).

- L1 was ‘Really looking forward’ to final year but, in December, she wrote of being ‘Very down lately’ and ‘I’ll be glad when this term is over and I can catch up on some reading’. Her stress levels were giving her insomnia. ‘The worst thing, for me, was getting a bad mark for the critical reading exam at the beginning of term. That made me think I have a huge mountain to climb’. In addition, she felt her seminar presentation went badly (see below. December 2004). By January, this student was ‘Wishing I hadn’t done Masters, as it would all be over now, and dreading the exams’. During inter-semester break, she wrote of ‘Trying to summon up some enthusiasm for the next semester and failing miserably … If I won the lottery tomorrow, I’m certain I wouldn’t complete the course and I never used to feel like that’ (February 2005).
- ‘I’m feeling very stressed out at the moment … I’ve been working as hard as I can but I seem to have so much work to do … I’m feeling huge pressure to do well, so I’m not enjoying it very much’. Contributing to this student’s stress was her desire to do well enough (First or 2.1 degree) to take up the offer of a PhD in cancer research (L11, January 2005).

One student was, however, ‘Quite calm’. She wrote that ‘Since doing a placement I feel more mature, disciplined and efficient about the workload’ and that ‘This semester has been tough, as I’ve been doing my project and lectures 9-5 every day, then having to fit the rest of the reading around that’ but that ‘This term has all been about time management’ (L9, November and January 2005).

By Spring 2005, L1 wrote of telling ‘A fellow student that I had run out of steam and she agreed and said she shared a house with a second year and three final years and the final years sit in front of the tele[vision] while the second year studies’. L18 was still enthusiastic and generally enjoying her studies but was ‘Finding it tough going and running out of steam a bit’.

Background reading was a problem for non-placement final year students: ‘You’re left feeling confused, you don’t know where to go for your extra reading or, if they’ve given you references, you don’t know where to start

because you don't fully understand the basics or the foundation' (L23, Autumn 2003). 'When you get three [reference papers] from every lecture, like ten lectures a week, that's thirty papers … and over the course of ten weeks … huge number' (L24, Autumn 2003) and 'Sometimes you just get a list of references, no titles … so you have to go through all 20 articles because he doesn't put the titles down' (L22, Spring 2004). For Neurochemistry, participants were given 'A reference of seven chapters to read for one lecture, and also two other references on top of that which are approximately 40 pages'; this was described as 'Madness' and 'Just ridiculous'. 'Sometimes the information is quite inaccessible … research articles that you've never read or understood before in your life … confuses me' but students feel that they should try to read them, even though their photocopying and printing costs are very high (L22, L23 Autumn 2003). In response to this stress, two students stopped doing any extra reading 'Simply because I don't have time to do it. If I tried to do it, I would stress myself out' (L25 Spring, L24 Summer 2004).

Some post-placement students had similar difficulties: 'Extra reading seems so complicated and full of hundreds of protein names to learn, which are hard when they seem meaningless. So how do you remember them?' (L17, January 2005) and references for Cell Growth and Proliferation were, for this student, 'Overwhelming … you don't want to read any!' L3 found this subject 'Very detailed, confusing nomenclature' (Spring 2005). L4 wrote 'When given a long list [of reference papers] it is sometimes difficult to be selective' and L9 wrote 'You can't retain a whole paper even if you do read it' (Spring 2005).

L12 gave Neuro-development as an example of the provision of references which worked well. For every two lectures, handouts were given 'Listing 5 or 6 reviews which he recommends you should read, together with some non-compulsory primary papers (Spring 2005).

One final comment on the effects of stress came from L22 after she had graduated with a first class degree. I suggested that she might consider doing a PhD and she replied: 'I never, ever, ever, ever want to do any single

exam ever again in my life, I know that. The further it went on, the worse and worse I got. I'd be a nervous wreck by the end [of a PhD]' (August 2004).

On seminar presentations

Some third year subjects are not 'taught' but consist of student seminar presentations. Many students seemed to hate these, at least initially, and to find them very stressful:

- 'I've never done a presentation, not even in tutorial' and 'I just find it a bit cheeky that the lecturers come down on us so hard, student presentations, when some of *them* are rubbish' (L23, Autumn 2003).
- 'We've got to do it in front of a class of sixty and also, during the presentation, [the lecturers] don't let you continue to talk, they like to fire questions at you while you're talking which means you lose your place and then you're lost'. Given their inexperience, this student finds it 'Ludicrous [that it's] going to count for a huge amount of the degree … they could have eased us in a little more gently' (L22, Autumn 2003).

The two students quoted above did not do placements but post-placement students also disliked giving seminars: early in her final year L17 wrote that she hated 'Presentations and talking to crowds'. Later, she wrote 'I can't believe how many presentations I have to do this semester. I suppose it's good for me but I'm just so scared!' (October 2004). In January 2005, she wrote: 'They were quite tough on the presentations we did …. at the end they had no positive comments, only criticisms, which made us all feel like crap'. L1 confirmed the negative impact of critical feedback by saying students felt 'Torn apart' (Summer 2005).

L1 wrote of Bioinformatics 'I haven't understood a word that has been said … I sat there while this girl waffled on unintelligibly for 40 minutes … if the people doing it don't understand, how can the audience?' 'I could have been learning something, instead of sitting there listening to her gobbledegook'. L1 remarked on the necessity for students to ask questions afterwards

because they are marked on their contribution in class: 'The whole thing is ridiculous'. She said Bioinformatics was too theoretical 'Like learning a recipe but without doing any cooking' (November 2004). When it came to her own presentation, it was 'Atrocious', and she wrote of being 'Very down' and said that 'Just thinking about it for the next week made me feel ill' (December 2004). She did, however, receive constructive feedback, e.g. add more examples to illustrate your point. By contrast, she received no feedback on either her essay or her presentation for Molecular Mechanisms of Disease; she felt capable of writing a good essay but had no guidance to enable her to improve (Spring 2005).

L4, L9 and L11 also hated having to ask questions and found they were 'Asking them however stupid they might be'. Several students (e.g. L11) felt they had no real choice of seminar subjects and had 'To present on a subject of no interest'; L19 picked phenylketonurea, 'Never heard of it' (Spring 2005).

Learning was variable from attending other students' presentations:

- 'You have to mark the other people so all I do is look at how they're talking. I'm actually not listening to what they're saying really, I'm listening to how they're presenting, because that's what I'm marking' (L23, Spring 2003).
- L19 learnt how to improve her presentation style 'Useful to see what kind of depth they went into, what aspects of the subject they included (Spring 2005).

Part of the Cell Growth and Proliferation module involved group seminars which was 'Very useful, learned a lot but everyone got the wrong idea. [The lecturer] explained at the end of the course that the presentations should have been "insight" and not a mass of information - should have been explained before, which would have reduced workload!' (L3). The same student described Biochemical Ethics as 'Very interesting but very stressful before own talk, overwhelming amount of info - [assessment] 100% seminar-

based' (Spring 2005). L2 did a group presentation for Biological Ethics which 'Was OK because it was quite informal and interactive' (Summer 2005).

L17's overall judgement on presentations was that 'Even though I hate presentations, they were a good experience. A necessary evil' (March 2005).

One participant described a good seminar course he had participated in and enjoyed for Enzymes in Biotechnology and Disease, where there were only about a dozen students in the group. The two lecturers hosted two-hour sessions in which the first hour was a student seminar and the second interactive discussion. A 'Particularly useful' element of this unit was the collection of feedback from fellow students giving one item that was good and one that could be improved about the presentation; this feedback was for the benefit of the presenting student, not for assessment (L20, Spring 2005).

<u>On lectures</u>

Bacteriology lectures were praised because 'We're looking at SARS [a respiratory syndrome] … prefer whatever is applicable to real life, rather than just a list of proteins' (L23, Autumn 2003).

Some students did not like what they saw as excessive detail or repetition, it seems, preferring to know broad principles and how to apply them. 'Why do I need to know all these names? Like signalling mechanisms, it's the same basic mechanism, just swapping the different names. As long as you've got the basic concept and how the different pathways work' and 'There's a lot of the right hand doesn't know what the left hand's doing 'cos we sit through lecture after lecture of what we've been taught last year or taught by someone else on a different course … like today we've had a whole neuropeptide lecture [and] we did all that last year and obviously they've not looked back. If you've done it before it gets very dull' (L22, Autumn 2003).

'Biology; a World View' was described as 'Too ambitious. Part of the course attempted to provide a historical overview of the science of biology over the

last 2500 years - in 8 lectures!! The idea was great but … some issues were addressed rather superficially and there was no room for debate or discussion … frustrating' (L20, Spring 2005).

As in earlier years, some lectures were seen as 'Not very well structured' (L24, Autumn 2003), Lecturer X 'flits about … you can't see the global picture. Her handouts are bitty, maybe pasted together from bits of PowerPoint presentations' (L12, L17, L18, L19, Spring 2005) and, when asked *'Do you think [Lecturer X] might be thinking about the subject more from her understanding than from yours?'*, 'Yeah, oh yes, totally' (L25, Autumn 2003). These final year students were surprised that this lecturer had gained a teaching award when students found her lectures confusing. (L22, L24, L25 Autumn 2003). Later, L3 wrote: 'They changed the structure [of Genes and Genomes] this year … didn't learn much from it … the range of topics was so vast that I had no idea what to focus on'. This student made detailed notes on all the topics, had insufficient time to memorise all the details and struggled in the exam: 'I could have answered any question they had set but not in detail. I ran out of time' (February 2005).

Proteins and Immunology lectures, on the other hand, were enjoyable (e.g. L1, Spring 2005). In this regard, final year students reiterated that the best lecturers use 'chalk and talk', and brief handouts outlining what lectures are about. It is better if lecturers draw their diagrams by hand, and 'You can see how they are constructed', rather than complex diagrams copied from articles. Students said they had never been consulted about PowerPoint, which they thought not as good as chalk and talk which restricts lectures to note-taking pace (L12, L17, L18, L19, Spring 2005).

Masters students took an Integrated MCB unit which involved different visiting lecturers each week. Eight of the lectures had to be written up as abstracts, news and views articles, articles for the Telegraph etc. In addition, there was an exam for which students had to read New Scientist every week. They were concerned that they had no idea what was expected of them and

had asked the Director of Teaching; he agreed to meet them 'After Easter [but] this may be too late for revision' (L17, L18, L19 Spring 2005).

BSc students took Data Interpretation (mentioned above as a source of stress for non-placement students). This unit involved alternating lectures and exams each fortnight. Non-placement student, L2, thought 'This module would be better assessed through coursework' (Summer 2005). Post-placement students said their placement experience was helpful in this module but even they felt ill-prepared for this unit; 'We've never done anything like this before'. Feedback following their first exam was helpful (L4, L9, L11 Spring 2005).

A module on Scientific Communication was popular; it was described as informal and good, different and exciting. Students worked in groups of five and enjoyed writing articles, designing a webpage and giving an oral presentation (L9, L11, Spring 2005). Masters students suggested it would be better to have this as a compulsory second year unit, so that students become accustomed to presentations, different forms of scientific writing, website design etc. (L12, L17, L18, L19, Spring 2005).

L1 mentioned that additional commitments and living many miles from campus made attendance at lectures more difficult for mature students. She said that having one lecture each day during semester 1 had occupied fifteen hours a week because of commuting. Webcam technology would be great for people in her situation. Those who wanted to attend lectures could do so but those who would rather not commute could view the lecture and make their notes at home. This would also reduce the pressure on university resources (L1, Spring 2005).

<u>On tutorials</u>

One student said that having to book an appointment to see her tutor 'Two or three weeks in advance [was] no good to me … he's meant to be there … if

I've got a problem I need to talk to someone now … he shouldn't have a tutor group because he is Head of Department' (L22, Autumn 2003).

L3's usually excellent tutor 'Recently seems in a rush all the time' but did later find time for discussion of his tutee's presentation for a PhD interview (February 2005).

On practicals

Students (both non-placement and post-placement) were critical of final year practicals.

- [Instead of] 'trying to teach you the techniques … some of them are like "you should know how to do that" and that's it, just get on with it … like the Neuro practical we've just done, they didn't even show you how to use [?]' and 'You get the basics if you do it every day but you don't … so you do forget things'. 'The general gist of practicals is that everyone hates them and does them as quickly as possible … no-one cares what they do' (L22, Autumn 2003).
- [Lecturers] 'tend to say like "You should know this now" … but I've done this once' and 'I hate them and I hate the pressure … horrible process to go through' (L23, Autumn 2003).
- Practical handbooks were described as 'Terrible … some of them are so ambiguous. Have they been proof-read before they were printed?' (L25, Autumn 2003).

Post-placement students were also critical of a practical class (Cell Membranes) where they felt 'patronised' by the protocol, and the fact that most of the procedure was carried out for them; they said they learnt nothing from doing it. When I mentioned '*discovery learning*' they shook their heads and smiled and one later wrote 'I don't think that I would call it discovery learning'. Demonstrators often haven't read the practical book and, if you get stuck, just give you the answers. Paying them £10.50 per hour seems like a rip off (L4, L9, L11, Spring 2005). It would be better to be given 'A

task/outline of experimental aims plus a list of solutions/equipment and some time to develop at least some of the protocol. The practicals here do not prepare you for "real" lab work' (L4, Spring 2005).

On final year practical projects

Non-placement students 'Didn't feel prepared for my project. You don't really do a lot on your own ever, until you get to your project, and then you're just chucked in there' (L22, Summer 2004). 'The first thing … was "Right, we're going to make up this standard solution … can you work out the molar calculations?" That threw me from the start but, once that was done, I actually quite enjoyed it' (L24, Summer 2004) and later 'I find myself getting a little bit excited when I know I'm going to get a result … I've really landed on my feet. [My supervisor] is an absolutely amazing guy' (L24, Autumn 2003). In contrast, L2's project supervisor was less good and she wrote 'My project tutor did not provide that much guidance and I didn't really know what I was doing to start with' (Summer 2005).

L25 did a computer-based project and was 'Glad that we did have to do a research project … it was a useful learning experience'; he was relieved that the Department offered non-lab based projects because thought of a laboratory project 'terrified' him (L25, Summer 2004). He had been unhappily stressed earlier in the year but 'I've got a bit more purpose at the moment, with my lab project … whereas before Christmas I was going to lectures and not really seeing the point of it much. So I'm happier' (Spring 2004).

Projects were, however, very time-consuming, e.g. 'I don't have a spare minute' (L23, Spring 2004). L24 was given a 'Key to my lab so I could get in there at 8 o'clock because I just wouldn't have the time to get it all in otherwise' and, when I asked whether they were allowed in the lab unsupervised, said he had been told "It'll be fine. Don't tell anyone" (L24, Summer 2004). These students thought 'The project is undervalued [in assessment terms] … should [count as] three or four modules to reflect the amount of work you do' (L22, Spring 2004).

One non-placement student found her project work 'Quite interesting [but] nerve-racking. I don't like being in there at all … you're in the way … [my supervisor is] so busy, I can see his face just falls when I knock on the door' (L22, Spring 2004). L23 said 'I'm sometimes in the way and I'd like to do more independently but, because it's a lot of new techniques, I can't … and that frustrates me'. She explained that her project involved using 'At least twenty different techniques' (Spring and Summer 2004).

When asked, after graduation, '*Did you learn a lot from having to do the project?*' non-placement students said:

- 'No, it wasn't really that relevant to any of the other modules' (L22).
- 'I learnt that you could really do 14-15 hours of work every day!' (L24).
- 'Although I learnt stuff, it hasn't really stuck … often it was so rushed' (L23) (Summer 2004).

Post-placement students thought that placement experience was a help when it came to their projects (L12, L17, L18, L10 Spring 2005) and, despite being time-consuming (e.g. 'Doing my project and lectures 9-5 every day, then having to fit the rest of the reading around that' (L9, November 2004), 'Takes up a lot of time so pushes some of my studies away' (L3, Summer 2005) and 'Not enough hours in the day to do my lab work and then do other work' (L18, Summer 2005)), the majority of post-placement students were happy with their projects (e.g. 'An insight into working in a different lab … learning new techniques', L18 Summer 2005) and the amount of support they received from postgraduates or staff (see below).

Students on the BSc programme had 'No choice as to which semester we could do our [project] dissertation in. We had to carry it out in semester 1. I would rather have done it in semester 2, as we would have had the Easter holidays to write things like Intro, Materials and Methods, and gather more references … that would have been really useful' (L11, January 2005). In Spring 2005, L9 wrote that 'There were a lot more interesting options last

semester, which was also the semester we had to do our project (didn't get a choice in that). Most of the modules I've picked this semester are more a process of elimination, rather than ones I really wanted to do'. L2 thought second semester modules 'Either dull or incredibly difficult, leaving me questioning if I am actually stupid' and gave Microbial Communications as an example (Summer 2005). For this reason, some students (e.g. L11, L12) took more units in semester 1, despite being busy with project work and found this 'Very stressful' (Spring 2005). A Masters student agreed that it was better for her, having her project in the second semester (L19, Spring 2005).

L9 wrote 'I don't think that the project gave me a lot extra, considering on placement we're working for a whole year compared to 10 weeks on the project. Although if I hadn't done a placement it would have been a sharp learning curve … I did get to do new methods and research something I didn't know much about'. In contrast, L5 found her 'Project much more informative than my placement; her placement had been low-key yet it was 'Definitely beneficial to have done placement year previously' (Summer 2005).

Whether they had (L3) or had not (L17) done MCB-related placements, what they valued about projects was 'Doing pure molecular biology' (Summer 2005).

L12 and L19 compared project and placement work: 'Lack of money here at uni makes an incredible difference'. L12 added that his placement lab was meticulously clean and tidy, 'With chemicals shelved in alphabetical order' but the university lab where he worked on his project was 'Overcrowded and disorganised' (Spring 2005). L1 said that her lab (a different one) was 'An untidy, disorganised mess … don't know how anyone can work there' and the write up room 'Is so overcrowded and cramped' but went on to compare her project supervision favourably with that which she received on placement 'My supervisor is really good, everything is explained, if I had had a years placement with her I would have learnt loads' (Spring 2005).

In Summer 2005, L19, wrote of the Masters programme 'We decide what to do each week and which experiments' whereas on placement she was 'Always told' and L4 'Had to work more individually whereas on placement it was more team oriented'. The latter student added that 'The project and placement gave me so much more to talk about in the interviews [for work after graduation] so I think they helped a lot and were very valuable!!'

Group identity

By the second semester of their final year there was some sense of MCB group identity 'Now that classes are a bit smaller and we do projects together. It helps to discuss things with "fellow sufferers"! and it might have helped to do things as a group before, e.g. practise presentations' (L4). 'Would have been good to do something like that earlier as I have started talking to people on my course I never did before, but we are so near the end of the degree now (L17) (Spring 2005).

On feedback from students

L12, L17, L18 and L19 felt that 'Feedback cards are just no good at collecting meaningful feedback as people rush and don't take them seriously'. They felt their feedback was ignored because 'Nothing happens … better to ask students what they think, talk to them' (Spring 2005).

On student feedback in Staff Student Liaison Committee (SSLC) meetings: 'Lots is said and nothing is listened to. Because [student representatives] made a complaint about a lecturer and they were told "You can't just complain about someone because you don't like them". We're not complaining because we don't like her, she's just not very good, and it was not taken on board at all. You don't criticise and that's it' (L22, Spring 2004).

Data on the MCB programme as a whole and on the University of Bath

Participants commenting on the programme as a whole said it was good and one they could recommend to others (e.g. L16 Summer 2005). They felt it was not as well known as, say, Biochemistry and should be promoted more (L22 and L23, Autumn 2003). L23 added that university life was 'About learning life skills as well. Having been to university, I've changed so much. Even if I don't come out with a good class degree, I've learnt a lot and got well equipped for life'. After graduation, L24 said 'If I got the chance to do it again, I'd do exactly the same. I've had a fantastic three years (Summer 2004).

When asked '*Do you get the feeling that you and the quality of your learning really matter to the Department?*' L3 wrote 'I think that the researchers (lecturers) generally make enough time to teach as well as doing research and they seem approachable … I think the Department values its students' (February 2005). [Interestingly, this student referred to academic staff as "researchers", then added lecturers in brackets. Also he had a caring tutor.] Others felt disconnected from the Department 'Like it's not there' and said that there was little support and encouragement, maybe because it was impossible with huge classes (L12, L17). By final year 'Some staff do seem to care and actually know who you are, recognise you' (L12) but not all - 'He doesn't know who any of us are' (L1) (Spring 2005). L2 thought the Department 'Elitist' and wrote 'Should be doing all it can to help average students and students like myself [with health problems] to achieve to their best ability … I feel they're not. I'm just not that good. Maybe had the Department been more friendly and supporting I wouldn't feel like this' (Summer 2005).

However, a recurring criticism was the variable quality of lecturers 'Some of them are hopeless public speakers' and 'Some of them do it because they have to and some of them enjoy doing it and you can tell the difference hugely' and 'It helps a lot if the lecturer actually wants to lecture us'. 'I don't think they have a lot of teacher training' and 'It shows' (L22 and L23 Autumn

2003) and, at a later meeting, 'If I was paying £3,000 to come to university I'd expect the person lecturing me to know how to teach. I don't think that's too much to ask' and 'You expect quality when you pay for something' (L22 and L23, Spring 2004).

Others felt that being at a research-based university explained 'The very low lecturing ability of many of the lecturers … they are primarily research people … being made to lecture us on top of what they do but they weren't hired as lecturers, they were hired as research staff. I think it's very much to our detriment' (L25) and 'A lot of lecturers lecture on something they really don't have an understanding of'; this student spoke of two lecturers as examples (L24). However, 'It's definitely helpful having those sort of people around but not helpful having that sort of people teaching' (L25) (Autumn 2003). In Spring 2005, students L12, L17, L18 and L19, thought it might work better to be taught by anyone good at teaching, rather than a researcher, for first and second year lectures 'To excite students' enthusiasm' and to have only those academics who really are good at teaching, lecturing on subjects that genuinely interest them for final year lectures.

Textbooks were also said to be of variable quality. *Molecular Biology of the Cell* (Albert et al, 2002) was good and so was Lewin's Genomes VIII 'Because it contains summaries of facts almost every page which helps you grasp new concepts' (L20) but there was no need to have bought the companion volume *Essential Cell Biology* which students were told to buy in their first year (L12, L18, L19). The fact that the Head of Department recommends his own book 'Doesn't feel quite right, as if he is taking advantage' (L17) (Spring 2005).

Feedback was another theme students returned to repeatedly. E.g. 'I would like to have received feedback from all my exams since the first year so that exam technique could be improved' (L4), 'If you get it at all, it's usually late … just a couple of sentences from the examiner to explain what was good and bad [would help us] do better at exams in the future' (L9) and 'One-to-one with your tutor would be best' (L11). L20 had, though, noticed 'They have

made more of an effort providing feedback which has helped me a lot in my learning. If only they had done this from the beginning!' (Spring 2005).

When asked, after graduation, *Do you learn because you want to know or do you learn for the exams?* L22 said, 'It's the exams' and L23 'If I'm honest, for the exams but I do always want to understand because I remember it better if I understand it. I *hate* it (her emphasis) when … I've just got to learn the words because I can't find the answer in a text book and can't grasp the concept (August 2004). In Spring 2005, post-placement students said that MCB was really interesting and that you had to have 'Genuine interest in the subject because it was hard enough even if you do enjoy it'. Some learning was just for exams but 'Sometimes you are happy to do lots of extra reading for your own enjoyment and interest. Having a choice of subjects helps with this - you'll do more for things that interest you' (L4, L9, L11).

Some students remarked on changes to the University during their time there. They used to think it was 'Great' but later felt 'There are too many people here' and that resources were overstretched (lecture space, computing, printing, library books, catering facilities, transport, parking). [The University is] 'Entirely financially motivated' and students feel like 'Lowly undergraduates - we're a burden that they have to lecture to … not important' (L24 and L25, Autumn 2003). In Spring 2005, L4 also believed that 'The University has already started to go downhill with too many people on campus and pressure for very limited resources' and added that other universities she had visited 'Have managed to increase their resources to keep up … but Bath hasn't'.

Individual Profiles

One of the major categories in my analytical framework is 'Learner Individuality'; this section examines a few undergraduates as individuals. One significant advantage of a longitudinal study is that it can reveal something of students' personal characteristics; it can also yield data on individual student's perceptions of their learning experiences over time and

so provide a more holistic view of the complexity of undergraduate learning experiences. Cross pointed out that '*Every* student … has a lesson to teach us about how students learn (p 7, emphasis added). Vygotsky recognised the importance of individual experience when he wrote:

> 'Experience is the kind of simple unit of which it is impossible to say that it is the influence of the environment on the child or a characteristic of the child himself. Experience is a unit of personality and environment as they exist in development … Experience must be understood as the internal relationship of the child as an individual to a given aspect of reality' (1984, p 382).

Profiles were selected according to the quantity and relevance of the data that individual students contributed; the following pages contain profiles of eight students. Some participated throughout the study while others participated for a shorter period but referred to changes occurring throughout their three or four years at university. Some profiles are based on data throughout, and some on part of, their degree programmes.

I should point out that this section is more subjective than others because, in addition to students' own words (from emails and transcriptions), I have included more material from field notes and my personal impressions of students. Reporting of these profiles is, therefore, a mixture of data and interpretation. I am neither a psychologist nor a sociologist and did not feel qualified to 'analyse' these data in any meaningful way but will comment on the students as individuals (in italics) after outlining each student's undergraduate experiences. Profiles begin over the page.

Profile of L1, over four years

L1 participated in this research from the beginning. She was in contact with me more frequently than other students during her placement and afterwards. As she put it 'I appear to have chosen you as my whingeing outlet' (August 2003) and described me as 'A really good resource for students' in this respect (Autumn 2004). She is a mature woman with a previous degree, a lower second, and was fearful that 2.2 might be the best she could achieve (July 2003). L1 wanted to achieve a First class undergraduate Masters degree (July 2004).

L1 felt that coming to university was 'Worse' as a mature student, 'Like you don't quite fit in'. In the first year, she did not enjoy practical classes and had done hardly any before coming to university. 'I worry about them a bit … panic a bit … I find it very pressurized' (Autumn 2001). Later 'I'm not very good at practical write-ups. I never know what to put in' (Spring 2003). She wished she had refused to do mouse dissections and said she learnt nothing from doing them (15 July 2004).

She was frightened of flying, and had commitments at home, yet opted for a placement in America, in a university research laboratory; she was there alone and, as it was a new placement, had relatively little background information beforehand. She was met on arrival and helped with accommodation etc. Her reason for doing a placement was that it was a requirement of the Masters programme 'Otherwise I wouldn't have done one because I've got enough work experience!' (Summer 2003).

On placement, she was initially bored and frustrated; 'I am doing a lot of reading at the moment. I'm fed up with it to be honest … I'd rather wash bijoux bottles, at least I'd feel I had a purpose … I wish I could be given something to get on with independently' and 'People here are friendly enough but it doesn't seem to have occurred to anyone that I might need some company occasionally of an evening … I am stressed because I am learning nothing and am at a loose end' (August 2003).

She had no confidence and little competence in the lab to begin with; she said that two years of university practicals had not provided the opportunity to become familiar with anything because nothing was repeated. Her initial lack of laboratory skills was the only adverse comment on her supervisor's otherwise-glowing assessment of her placement (15 July 2004).

By early September 2003, she had a project 'I have a goal and am now doing things. Nothing seems as complicated as I thought or as Bath practicals can make you think … it would have helped me to have my mol[ecular] biol[ogy] practical book returned before I came here'. She also drew comparisons between university and placement learning: 'Here there is more thinking time, planning and understanding. In Bath, you never really have time to get stuck into something as there is such a mass of lectures, essays, tutorial work and

practicals … you think you understand … but through not repeating it or not spending enough time on it, it doesn't sink in … [but] good foundation … however sketchy'.

In late September 2003, L1 wrote that she was enjoying the placement laboratory work very much but dreaded weekends; she found the lack of social life 'awful', was 'deeply depressed' and had 'just about had it with all things American'. She was very lonely for much of the time - 'I work pretty much alone in the lab … I don't think [her supervisor] is into team work … this year is stretching out before me interminably' (October 2003), 'Social life is still a disaster … my secluded existence' (November 2003) but she worked hard to establish a social life (going to yoga, skiing etc) and achieved some success by the end of her placement. It was, however 'truly wonderful' to be home again (July 2004).

The research this student was engaged in had its ups and downs, periods when experiments were unsuccessful, cells died etc but she was often 'quite motivated because I really want to get some good data … planning my own work and in a hurry … cram a lot in' (November 2003). She wrote (in January 2004) that 'it is interesting and I have to do a lot of background reading. I wish I could concentrate on this but I am distracted by [work for her Masters] … I actually like the problems because they make me think and reason. I think everything we have done so far is learning and regurgitating in exams'. Later, she said that students were promised feedback on their Masters work but, by July 2004, had received none. Having feedback on the first problem before tackling the second would have been better (July 2004).

In February/March 2004 there was another period when the research was not going well and 'I am not learning anything because I am doing the same thing over and over again and not knowing what I am getting wrong'. However, this student was by then thinking and acting independently of her supervisor who 'jumps to conclusions with data that I don't always consider reliable' and she discussed her research with another colleague, 'a PCR expert [who] thinks my program is about 20 years out of date and is all wrong for my enzyme … not sure how to tell [my supervisor]'. After this, the consistency of her data improved dramatically. When her supervisor was away for four weeks, L1 wrote 'I don't suppose I will notice the difference!' and in April 'I feel more confident in working on my own now, especially when [my supervisor's] comments are neither relevant nor helpful'. Later this student wrote 'What fun it is when things work!!' (May 2004).

L1's supervisor valued her opinions and she found that 'empowering', and she thought that the Biology & Biochemistry Department should be more appreciative of supervisors' contributions, but he 'doesn't keep himself up to date' with some laboratory work.

In April, she wrote 'I know I want to work in research, I love just finding things out … working in the lab has made a difference' and 'I was thinking that I would like to do a PhD'. She expected to be first author on a scientific paper

(15 July 2004). Her supervisor wrote her a 'Really over the top reference' (March 2005).

Despite looking forward to final year, L1 struggled; she suffered from insomnia which she attributed to final year stress. 'The worst thing for me was getting a bad mark for the critical reading exam at the beginning of term that made me think I have a huge mountain to climb. I think I am very worried about failure, more than I realised' and 'Very down lately because my Bioinformatics presentation was atrocious … Just thinking about it for the next week made me feel ill' (December 2004).

In March 2005 L1 wrote 'I got things out of perspective, overworked, made myself ill and had no time for anything else. This term, because I can't keep that up, I'm more relaxed … feel as though I have run out of steam for the course but I think it's about balance … I have stopped enjoying it because I have turned it into an obligation'.

L1 achieved a First class undergraduate Masters degree, MBiol (MCB) and has gone on to study for a PhD.

The transition to university may be more difficult for mature students. The fear of failure also seems to have had a major effect on this student's life at Bath. She was encouraged by success with her placement project to consider a research career. On the other hand, she was deeply discouraged by 'failure' in the form of poor exam results and a bad presentation. She worked hard, perhaps rather too hard for the sake of her health, and seemed to need, and benefit from, the opportunity to 'whinge'.

Profile of L3, over four years

In school, L3 learnt by going over questions until he got them right, he revised by having 'big sheets of paper around the room' so that he could revise wherever he was. While at school, he was taught some study skills 'How to do these mind maps, where you write key points and draw flow diagrams that lead to different information and shown how to condense your notes a bit' (Spring 2003). This student said he was 'definitely not taking it for granted being [at Bath]' (Autumn 2001); his school was not very good and he felt pleased to be accepted by a good university (Summer 2003).

At the beginning of first year, L3 believed that the only way to learn was to copy out notes and add detail from the textbook - although he quickly had a backlog of un-copied notes (Autumn 2001). When asked *'Were you given any guidance on how to learn, on the MCB course?'* he said no but thought there was 'an optional course how to do that' although he did not know of anyone who took it. 'That would have been good' (Spring 2002).

Later in his first year, this student thought that 'dissecting a mouse … was really interesting, seeing what it looked like. Apparently it's the same as us humans' (Spring 2002). He wanted to 'understand' the background to the practical classes and was disappointed that he was not given this opportunity beforehand, saying that he 'prepared for the next practical by reading the next [section?] but they skipped that one and went on to the next' (Spring 2002).

This student became 'absorbed' in the textbook he was reading for a tutorial essay (Spring 2002). He liked lectures where he could write down key points and read follow-up references but, when this was not possible, wrote everything down in case he missed something (Spring 2002). He saw connections and overlap between different subject areas (Summer 2002).

During first year, L3 said 'My tutor gives me lots of exam questions to do … and a 50-minute presentation on it … really good … forces you to learn … really helps' (Summer 2002) and, in second year, 'Quite impressed with the way my tutor has been … he asks us what other essays we've got and what work we've got and adjusts [tutorial work for] when we have time. He even lets us change our essay title if we didn't think it was good enough … that was very good. Then we went out for a drink with him yesterday, about eight of us. He really seems to care what we do, how our work's going' (Summer 2003).

L3's second year revision involved 'writing a lot more … I learnt how to revise a bit better and actively get it into your brain instead of just sitting there reading it from a book … write little notes on the side and then check. Little diagrams and things' (Spring 2003).

He involved himself in many additional aspects of university and placement life including Japanese classes, volleyball, music, diving, mixing with

international students 'learned a lot about their backgrounds and cultural differences, which I'm really pleased about' (November 2003), learning French again, skiing, diving, travelling and campus radio.

This student chose to do the Masters programme because 'I really want to go into research, so a Masters placement would be good'. He thought it 'An ideal opportunity to really get to know what it's like working … practically in the lab'. He had learnt from final year students that they learnt a lot of techniques etc from their placements (Spring 2003).

His placement was in an American university research laboratory and he shared accommodation with another MCB student from Bath. Before he left England, he felt he already knew future colleagues through email exchanges and quickly settled down ('acclimated') in a friendly and 'welcoming atmosphere … everyone is very interested in what everyone else is doing'.

In July, L3 was 'really enjoying working here, even though I'm working from 9am to 6.30pm' or later and some weekends but had a brief period of being 'very ill'. He was impressed that his supervisor took him to the medical centre and waited with him for five hours. Social life was full and varied, including a welcome party (July 2003).

In October, L3 was briefly bored and homesick but by November his supervisor gave him a different task and 'I really like all the responsibility' and 'realising more about real research'. This participant said he was 'really learning a lot' and that the way he learns is 'to become immersed in the subject and not by blindly following protocols [and by] discussing the problem with work colleagues, especially [his supervisor] … presentations are also an excellent way of learning a subject - it really clarifies/organises the information because you have to display it in a way that any other scientist can understand what you're going on about'. When asked what might hinder his learning - 'A poor working environment. For instance, I don't think I could learn if I was constantly pestered for results or treated like I was near the bottom of the ladder, which I am not!'

Before Christmas, this participant reported making 'great progress with my projects … big achievement' and said his supervisor was so pleased that he organised 'beer at work to celebrate!' L3 was primary author on two scientific papers.

At the beginning of final year, L3 described his placement as 'Work hard, play hard' and said he introduced at least two innovations to the work of his lab. His supervisor told him that he was in the top 5% of students, with regards to his ability and "spark" and had offered him a PhD in America (October 2004).

Despite having coped well for three years, L3 began to feel the pressure in final year. 'It was hard to cope, anxiety mostly … I am OK if I have one thing to concentrate on but, if there's more [I don't] know where to start! Horrible feeling knowing that you have so much to do!' (January 2005). He found it 'Extremely stressful' having multiple deadlines (February 2005).

L3 applied for PhD studentships in Europe and 'Caused quite a stir [at one institute] and talked to many more group leaders than I was meant to … received four offers … accepted the one I think is most interesting [with someone] extremely creative'. The PhD 'will involve a lot of thinking and designing experiments … can't wait to get started' (March 2005).

L3 achieved a 2-1 MBiol (MCB).

This student had ability and was lucky in having a supportive tutor, a good placement supervisor and a nurturing placement environment. Despite finding final year difficult, he seems set for a promising research career.

Profile of L5, over four years

Before university, this student attended a private crammer where there was a high staff: student ratio and students learnt by 'going over and over things'. They had a system of rolling revision throughout the year, adding an extra week's work to their revision each week.

This student wrote that practical classes were her favourite part of the course as 'they help consolidate lectures and they are a fun way to learn' (Spring 2002). Later she wrote that 'practicals are the best part of my week … as I learn more from hands on work' and that reference articles were 'fun as it feels like we are real scientists now' (Spring 2003).

L5 undertook a UK-based placement with a research institute. The type of work she was doing involved, amongst other things, computer work ('Spreadsheets are now my life!') and testing packaging for strawberries. My impression is that the work was not very challenging. She described the work as 'very hands on which is great', said she felt 'very grown up and … fairly independent' and that 'it feels as though the project is my baby!!' She missed university friends 'terribly' and found it hard to make other friends in a 'rough' area (September 2003).

In April 2004, she wrote that she had learnt many transferable skills, mainly from computer work, but that 'work can be somewhat repetitive … career wise I don't want to go into scientific research. There is too much focus on money or lack of it and I think that the worry of finance detracts from the science and also the enjoyment. So many projects are not executed due to lack of funding and I think I would find that far too futile'.

In final year, she wrote that she realised now 'That so much extra reading of journals and text is needed to understand the point and get some meat behind the subject' and was 'So glad for the placement year for me to do some maturing'. Commenting on her final year project, she wrote 'I am working on the mutation frequencies of MRSA, very grown up!!' (November 2004).

L5 obtained a lower second BSc.

This student was not, or not yet, a good learner and raised a number of questions in my mind. Did her time at a crammer influence the approach she took to her university work? Would she have benefited more from coming to university later, when she had some maturity? Her placement was low-key. Was an undemanding placement appropriate to her abilities or might she have grown into a more challenging role? Does the lower second BSc she obtained represent her maximum potential?

Profile of L9, placement year

L9 was motivated to do a placement because her mother worked for a science recruitment agency and 'advised that having a placement puts you on top of the pile' (Autumn 2001). This student looked on her placement as a 'year to try different things and find out what you do or don't want to do afterwards' (Spring 2003).

Her placement was with a UK biotechnology company. She visited the company and met fellow placement students in advance ('takes the tension away when you know who you're living and working with', Summer 2003) and was given comprehensive induction training (October 2003).

She enjoyed both work and social life, sharing accommodation with five others with whom she got on 'really well'. 'A really nice company to work for and everyone seems very happy … we have talks from different people in the company every Friday [and] lecturers from universities do talks every two weeks and there is a lot of social stuff'. She felt that 'what I'm doing is important and worthwhile' and wrote that 'actually doing something helps me learn; it's only when I actually carry out a protocol that I can understand and remember … same with note taking, I can never learn by just reading [scientific papers]', she highlights and takes notes.

L9 drew a number of comparisons between placement- and university-based learning:

- 'At uni there is so much I needed to do that I rushed … On placement … you start to understand and sit and ponder why has this happened etc.'
- 'In Bath, reagents were previously made and some sections of the practical were carried out for you but when you have to do absolutely everything [yourself] you get a better understanding of what's going on.'
- 'I'm doing a cell-based assay that takes three days to do and is very complicated to understand but I've repeated [it] and every time you enhance your understanding.' There is almost no repetition at university.
- 'The best thing about placement is I get home at 6pm and have nothing to do but relax and enjoy myself, same with the weekend. At uni it's constant workload with no real break. You can't come home and say "I've got no work to do". Even if you don't do any … you know you should. I think this hinders learning' (August and October 2003).

By November this student was 'really getting into my project now, so I'm busy which I like … it's good now that I don't need any help in the lab' and wrote that 'a good atmosphere always makes you more motivated to work'. In April, she wrote that feeling her work was important 'makes me want to do everything as precise[ly] and thoroughly as possible' and that she could perform familiar techniques 'standing on my head'. She felt that she had 'learned a lot about immunology, eye biology, ELISAs, some stat[istic]s and

biochemistry through both the techniques and results I'm getting and also through research for my report'.

Also in November, 'I feel more like a proper scientist now, because I now know a lot about this specific area. I can talk to people confidently about my results and understand what they're talking about, which I couldn't when I first started'.

As a consequence of her placement, L9 felt 'More mature, disciplined and efficient about the workload' and her 'time management' (November 2004 and January 2005).

L9's approach was business-like. For her, university was about getting a good degree for her future employment. She made a good job of her placement and felt 'Disciplined and efficient about the workload [and] time management' in final year. This student may, perhaps, have aimed for operational competence above academic understanding (Barnett 1994) and have mistaken efficiency for effectiveness. However, this approach served her well; she reported feeling 'Quite calm and obtained an upper second BSc.

Profile of L16, placement year

This German student undertook her placement in a prestigious research institute in Germany, continuing the work of a previous Bath student. She had no break between exams and starting her placement, and found it 'difficult to get into the new work rhythm and to find enough energy'. She was initially pleased with her laboratory work and proud that she did well; at this time she was enthusiastic, e.g. 'a paper I found interesting' (August 2003).

In April, L16 wrote about learning technical and professional skills:

'I learned how to design gene specific primers and to use them to isolate from a cDNA pool a gene sequence of interest … how to amplify this sequence using RT-PCR and do subsequent *in vitro* transcription to obtain corresponding mRNA sequence. I used this for doing non-radioactive *in situ* hybridization, using an automated method. Furthermore, I learned how to dissect mice, embed mouse brains in a special medium and section the brains, using a cryostat, and fix them. I also learned how to take care of mice, feed them, change cages etc.'

She learnt to be more questioning and to think critically 'Is this statement right? Was the experiment correct?' and also 'How life in a lab is: colleagues, supervisors, working hours etc. It was very difficult getting used to all this but a valuable experience' (April 2004).

Since I happened to know that her predecessor at this institute (an English biochemistry student who emailed me often from his placement) had a bad time there, I thanked L16 for her '*useful information*' and added that '*it would be even more helpful if you could just tell me how you feel about the work you do, the supervision you receive and the social atmosphere you live and work in - it may be that there are links between what people learn and their placement situation, I'm trying to find that out*' (16 April 2004). I did not, of course, mention the previous student's problems. In her reply, she wrote 'I am not very satisfied with my placement … almost exclusively doing *in situ* hybridizations with an automated method. This is very disappointing since the main purpose for doing a placement was to learn many different techniques. Furthermore, I have no supervision. I am missing someone [of whom] I could ask any questions at any time, regarding experiments or more theoretical questions'. In addition, this student had colleagues who were unsympathetic and teasing towards her coeliac-disease induced diet. She added, though, that 'although it was a hard time I also learned very much' (April 2004) but 'I would not recommend the institute to another student' (July 2004).

Despite the prestige of the research institute where this student worked, her placement was not a success because she was given only repetitive automated work, felt she had no supervision and unsympathetic colleagues.

Profile of L19, placement and final years

This student, on the Masters programme, was the first from Bath to work at a new research institute in America. She was met on arrival and quickly made to feel welcome.

Initially 'quite lonely and … very worried about being able to cope … My biggest problem is the maths. I find it very hard to do dilutions, work out the volumes of enzymes and buffers' (August 2003). In September she emailed asking for advice because she was 'not very happy … have my up days and extreme down days and they chop and change so quickly … [lab work was] unsuccessful … disheartening to keep getting it wrong … makes me feel very inadequate. Most of the things I am doing now I have never done before or done once. I just feel completely useless' in addition, she still felt 'very isolated' and 'quite lonely'.

Within a few days she wrote that she 'had such a good day today, I got my PCRs to work and some other things too! I'm also going out tonight … and Friday night'. She quickly became 'much more able and independent and my relationship with colleagues is getting better and better, it's almost like having a second family! I'm really enjoying myself here although it's very overwhelming … I am surrounded by some of the most talented and amazing people in the cancer research field … very honoured to be working in such a respected institute … fantastic learning experience'. The working atmosphere was supportive and forgiving and, when she confessed to a silly mistake 'every single one of them said "Yep, I've done that too" … so I felt better and haven't done it since!' (September 2003). 'It is surprising how much I can learn by listening to my co-workers discuss their experiments' (February 2004).

Also in September 'I am going into work tomorrow (Saturday) and have enough to keep me busy all day!' (She did not appear to mind) and, by November, she was obviously excited by her experimental results.

One advantage of this research institute, this student reported, was weekly seminars on aspects of cancer research 'It was fantastic' (September 2003) and weekly lab meetings where 'I present all my work every 6 weeks or so' (January 2004). She learnt a lot about Genetics, which she used to find difficult, as well as about Cancer (April 2004).

'I have learnt so much here through working with truly talented and intelligent people [who] make a conscious effort to explain things and go into lots of depth and detail … I am also constantly browsing [a medical website] and reading lots of papers … this helps me to gain a great insight [into her specialist area]'.

L19's busy social life included American football, clubbing, line dancing, films, quad-biking and much more.

By April, L19 wrote 'I am now sure that I want to go to grad[uate] school and do a PhD … before I was almost sure I didn't want to do one'.

By September of final year, this student (who friends described as 'very intelligent') was 'Eager to get back into the swing of things' but, within ten days of returning to university, the Critical Reading exam had left her in tears (October 2004). In March 2005 she described herself as very stressed and explained that it is her nature to be 'up and down' because she expects herself to be perfect all the time and worries that she might not be.

By the March L19 had changed her mind about going on to postgraduate studies and given up all thoughts of a PhD. She even wished she had done a different degree from MCB, which was 'too research oriented' and thought of becoming a paramedic (April 2005).

L19 achieved a First class MBiol(MCB).

L19's placement contrasts well with that of L16 because her colleagues were 'Like a second family', helpful and supportive to such a degree that she intended to do a PhD. Final year at university may have put her off the idea of postgraduate studies; despite getting a first class undergraduate masters degree 'I'm going to get a job now' (July 2005).

Profile of L20, over four years

Most of this data comes from meetings in final year, October 2004 and February 2005.

This Anglo-Spanish student came from the European system of education and had taken both International and Spanish baccalaureates. He felt that university practicals didn't allow any independent thought. When his first year essay on The Nature of Intelligence was criticised for having too few references, he felt he was being told to 'quote what others thought rather than writing what I thought'. He wanted to explore his own thinking but felt that students 'All come out thinking the same way, i.e. thinking scientifically' (February 2005).

On his placement, he wrote 'My supervisor did not contact me until I arrived in [America] and didn't really tell me anything about the project or the place' and the only contact he had beforehand was 'mail full of publications from the lab'. His initial reaction was that his placement was 'Very enriching and educational'. He wrote that 'The lab is regarded as one of the best of its kind' and 'I find the project itself very exciting'. At first, his direct supervisor was very helpful and supportive and for a couple of months they had a good relationship, discussing science all the time, which gave him a real buzz. He felt enjoyment/excitement at being immersed in thinking about science. At this stage, he was very glad to be doing a placement, was full of ideas, felt creative and thought he would definitely do a PhD (October 2004).

After a few months, however, his supervisor suddenly became distant and critical. He felt hurt and confused but knew he had done nothing wrong so tried to work harder to win back her approval. His working hours became very long (sometimes fifteen hours a day). During this phase, his friend and flatmate emailed me with his 'concern' and asked for advice (L3, March 2004). L20 had two minor accidents during this time, once when he was in the lab on his own and once when his supervisor 'became hysterical and I got nervous and injured myself' (he poked a needle containing acrylamide into his hand). Sometime later he heard that his supervisor had acted in a similar way before, towards a colleague; they believed she was 'emotionally unstable' (October 2004).

From January onwards his life was very tough and he suffered 'bullying and harassment'. 'I'd lost my confidence. It affected my personality. I was confused, I fell apart, was in a mess. I won't take that kind of shit again if I am ever in a similar situation at work' (October 2004).

Initially, L20 was reluctant to tell the Biology & Biochemistry department, hoping things might improve. He was afraid to tell the Lab Head in case it made matters worse with his supervisor. Eventually, when he was getting desperate (and perhaps acting on advice from me, e.g. February 2004), he emailed the Director of Placements. She replied but 'Took several weeks

to do so due to problems accessing her email account'. L20's parents became so worried that his father phoned the Director of Placements who then called the Lab Head. Neither the Lab Head nor the Director of Placements told L20 that they had spoken, and nothing changed regarding his immediate supervisor, but the Lab Head did pat him on the back a couple of times and ask if he was OK. His gestures of support were too little, too late (October 2004).

L20 described his Lab Head as a nice man, personally, but very busy, often away and not approachable. He was 'completely driven', competitive and ambitious and ran a lab with an atmosphere to match. He apparently believed in divide and rule, giving two people similar projects in the expectation that competition between them would motivate them to produce results quickly. People were not encouraged to be cooperative and L20 was told off, by his supervisor, for sharing results with a lab colleague. As far as L20 was concerned, 'Real life research isn't about being nice, it's about being aggressive and competitive. First man takes all.' Towards the end of his placement, L20 wanted to avoid the pressure and competition of scientific research and planned to leave science after graduation (October 2004).

This student felt particularly let down and frustrated because the early months of his placement had shown him how exciting scientific research could have been if he had been allowed to fulfil his ideas and suggestions. He found it very painful that all he could do with these ideas was to include them in the "future directions" section of his final presentation before leaving his placement (October 2004).

Despite his bad placement experiences, L20 looked forward to his final year and wrote: 'I now know how fortunate I am to be a student and not under pressure - just able to learn and read what I want to. It's a privilege. Never felt that before … didn't really appreciate it. Never again will I have the chance to read around the subject as much as I want to. I'm determined to make the best of every single day this year'.

L20 achieved an upper second MBiol(MCB) and planned to do a Masters degree in the History and Philosophy of Science (April 2005).

This student's placement experiences were very unpleasant. His creativity was not nurtured and he was left feeling that scientific research was a cut-throat business in which he wanted no part. He did, however, continue to be interested in reading around his subject and in the philosophy of science.

Profile of L25, three years. No placement

This student was interested in theoretical Molecular and Cellular Biology, rather than practical science; his choice of degree was 'completely non-vocational' (Autumn 2003). He did not want a career in MCB and did not do a placement. I first met him at the start of his final year and field notes show that I was worried about his stress levels, to the point of considering whether or not to inform his tutor. After much deliberation I decided not to because I felt that his friends would be able to support him and that he was therefore not at risk. By the time of our next meeting he was noticeably more relaxed (Spring 2004).

Several of this student's early university experiences were rather negative. He referred to Remedial Maths in the first year very negatively, loathing the word 'remedial' (Autumn 2003). Even after graduation he wrote that this unit was a 'total waste of time', of 'no relevance' and complained about the poor teaching quality. His experience of Organic Chemistry was no better; it was of 'no noticeable use for the rest of the course and … served as [an] assault on personal confidence … as I didn't do at all well in the exam, helping to create a rather negative mindset, which I retained for the following 2 years!' (Summer 2004).

Throughout his time as an undergraduate he loathed and was 'terrified' of university lab work (Summer 2004), attested (he believed) by his heightened heart rate during practical Animal Physiology classes (Autumn 2003). In final year he found background reading very stressful and, for a while, didn't do any 'because I don't have time to do it. If I tried to do it, I would stress myself out' (Spring 2004). He was 'glad that we did have to do a research project … it was a useful learning experience' (Summer 2004); his project was computer-based, not lab-based. Interestingly, while doing his project he said 'I've got a bit more purpose at the moment, with my lab project … whereas before Christmas I was going to lectures and not really seeing the point of it much. So I'm much happier'.

This young man seemed particularly appreciative of the opportunity to chat afforded by participation in this research during his final year:

- 'Provides some of us with a way to let off a little steam!' (March 2004).
- 'Many thanks for giving us the chance to talk to you over the last year … useful experience - just for getting stuff off my chest' (June 2004).
- 'Once again, thank you for this cathartic experience … you've definitely helped ease the passage through this (final) year' (July 2004).

He graduated with a First class degree and plans to do a research Masters degree in Bioinformatics; 'the decision to do bioinformatics was based heavily on the success of my project' (Summer 2005).

This student did well but it was not easy for him. He seems to have been

very discouraged by academic failure at the beginning of his time at university and to have found it cathartic to let off steam. As with L1, having an outlet for negative feelings apparently helped L25. Importantly, it did not seem to be the weak or lazy who sought my support; on the contrary, it seemed to be those who aimed for success but worried about their possible inadequacies or the prospect of failure (other examples were L19 and L22. All four of these students achieved first class degrees).

L25 was very articulate in his criticisms. His views on teaching quality may not have been shared (or at least not to the same extent) by his peers. However, it would be wrong to dismiss them as 'extreme views'. It is more constructive to ask why he felt that way; it seems that negative experiences of Remedial Maths and Organic Chemistry, some poor exam results and practical classes which he found terrifying helped to 'create' his 'negative mindset.' On the other hand he seems to have been encouraged by final year success.

I have given profiles of only eight out of the seventy students who participated in this research and they are not intended to be representative, merely illustrative. The group as a whole, during the period of this research, also experienced the death of a parent, the making and breaking of significant relationships, an acrimonious divorce, clinical depression, an attempted suicide, success in sport, illness and injury. All these life events are likely to have had some impact on the individuals concerned, both personally and as learners. In addition, students themselves are very varied in temperament and ability or potential, they have had different experiences before coming to university and they have differing experiences during their time as undergraduates. For these reasons, a one-size-fits-all approach to their Higher Education is unlikely to be successful, even at programme level.

A brief glimpse into academic staff perceptions

One theme of this research, which students referred to repeatedly, has been teaching quality. I therefore decided to ask colleagues from the Department of Biology & Biochemistry (one professor and two lecturers) for their perceptions of learning to teach at the University of Bath. Data were collected by email in February 2005, although the lecturers had first spoken to me about their experiences in 2001-2002.

Before answering my enquiry on learning to teach, the professor wrote some of his thoughts based on over twenty years experience of teaching a second year course, jointly with a colleague:

[We] 'teach the course entirely with overhead transparencies, copies of which we distribute at the appropriate lectures as handouts. A few years ago, because of urging from our current Director of Teaching, we considered 1) putting these on the web and 2) using PowerPoint. I put these proposals to the students … unanimously said that it would be a waste of our time. They say that PowerPoint often encourages lecturers to proceed too quickly and the use of a darkened room inhibits the asking of questions during the lecture'.

The professor's second point concerned the use of 'Chalk and board … if a lecturer has to write things down, this necessarily slows one down to student note-taking pace, so they LOVE the handouts and transparencies and especially the chalk and talk approach … in fact, they are quite fed up with the sole use of PowerPoint from their first year. My conclusions are confirmed by the quality of our student feedback scores which … amongst the highest in the Department' (original emphasis).

On learning to teach, the professor wrote that he had not been required 'To undertake any of these staff development "opportunities"', but had acted as an internal assessor for a lecturer 'Who was poor to begin with and, from all reports, hasn't improved'. The professor wrote that, as an assessor, 'I had to plough through a pile of documentation weighing >5kg that was ~8" thick! This was patently and manifestly … a total waste of [the lecturer's] time and mine - in fact everyone's except those whose careers depend on staff development initiatives'.

The two lecturer participants had experienced the Institute for Learning and Teaching (in Higher Education, now part of the Higher Education Academy) course at the University of Bath when it was newly introduced. The first wrote 'I can't say too much that is positive', that both the handbook and the portfolio were a nightmare, that Staff Development personnel could be 'chaotic' and that the reading might be OK if you had time to do it but, in reality, you didn't. He felt that he was having to push buttons or jump through hoops for assessment by 'beanocrats', rather than to produce good teaching. He went on to give his overall summary:

'It was well intentioned but poorly executed and designed, and simply not living in the real world. It's an expression of people thinking about teaching, not actually doing any teaching. I gained about 10% benefit from what was taught (i.e. 90% was bleed'n obvious).'

When asked for '*Any suggestions for how it might be done better?*' he wrote: 'I'd have a couple of days going through the basics, psychology, etc. I'd have

the participants sit through a poor lecture and then a good lecture and then ask them what was bad/good. I'd organise some question sessions with experienced lecturers. I'd then assess progress by randomly attending the lectures of participants and debriefing them afterwards. Portfolio is rubbish and would not be considered.'

The second lecturer echoed many of the points made by his colleague, saying that the quality of courses was often very poor, that the courses and course material were often not relevant to teaching scientific subjects and in huge groups. Further, there was no check on his teaching quality and that it often felt like ticks in boxes to say you've done something, rather than being truly worthwhile.

They said that Staff Development had tried to make some changes and that the course had been streamlined somewhat but one added 'I won't say that the courses are perfect and much of what I said previously is still true, but they are moving in the right direction'.

Data from published sources

All the foregoing data have been empirically derived. As mentioned above, additional sources of data were used in the analysis, in the form of information published by the Department and the University on their web pages. This is introduced in the following chapter.

* * * * * * * * * *

Apart from the small amount of data from academic staff, this chapter has reported data from the four-year study into undergraduates' experiences of their degree programmes. Chapter 7 will analyse participants' data, beginning with students' experiences of placements; it will test the model and refine the framework described in Chapter 5. Chapter 8 will be a discussion of the research findings.

CHAPTER 7: DATA ANALYSIS AND FINDINGS

The previous chapter contained data on undergraduates' perceptions of their learning experiences; these data are rich and interesting but, like a survey, tell only what students perceive and not why. Relevant findings can only be revealed through appropriate analysis. In this penultimate chapter, data from the longitudinal study (Chapter 6), plus some additional data from supplementary studies (Chapter 4) will be analysed using a socio-cultural and activity theoretical approach in an attempt to reach some understanding of undergraduate learning. The final chapter is a reflection on the research findings.

In Chapter 5 I outlined my developing analytical framework which consisted of four major categories based on socio-cultural theories of learning: 1) Activity, 2) Mediation and 3) Learner Individuality were seen as the major factors affecting 4) Learning Outcomes. That framework will be further expanded in this chapter.

In this analysis Activity is variously defined, depending on the research perspective, but major activities, from the point of view of undergraduate learning at programme level, are 'Doing a degree' and 'Doing a placement'.

Mediation is taken to mean socio-cultural semiotic mediation, i.e. anything from which a student can derive meaning, make sense or gain understanding of their subject, themselves, their world and/or their lived experiences. No distinctions are made between, for instance, verbal and non-verbal signals or between written and spoken language. Mediating artefacts, both physical and mental, material and conceptual (Cole 1996) are given equal weight; tools, ways of thinking and acting, social interactions and so on are all important in meaning-making. There may (or may not) be some merit in distinguishing between such artefacts involved in the local situation, whose effects may be quite obvious (such as the influence of a placement supervisor), and those which come from the wider cultural milieu, whose effects may be quite subtle (such as the use of the word 'sacrificed' in

scientific literature describing experiments where animals are killed to supply organs for research).

Culture is seen as analogous to interstitial fluid or artificial growth media in which cells are immersed and in which they grow, develop and differentiate. Each individual takes from and contributes to the culture in which they live and of which they form a part as do cells within a tissue. As Vygotsky pointed out in *Mind in Society* (1978), mind emerges in the joint activity of people. Further, there is a reciprocal relationship between individuals and their cultures; mind and culture are "co-constructed" (Cole 1996). Cultures vary across historical time and from place to place and the nature of an individual's knowledge and understanding is moulded by their particular time and situation and by specific types of socio-cultural exchanges. Culture is a highly pervasive form of Mediation. Each of us interacts in a number of different socio-cultural settings, for example at university, on placement, in the family, with our friends and so on and our identity is influenced by a complex set of socio-cultural influences, by our personal trajectories (Dreier 1999).

Learner Individuality was difficult to define and in many ways beyond the scope of this research. However, individual ability, previous learning experiences, approaches to learning (Marton and Säljö 1976), personal perceptions, stances (Savin-Baden 2000), social background and psychology are all likely to affect students' learning outcomes and their identities. However problematical it may be, individuality cannot be excluded from this analysis. The data contain only glimpses into some aspects of student's attributes, perceptions and undergraduate experiences but these do give some clues to their individuality (see especially profiles pp 183-198); these can be used to describe the Subject(s) involved in an activity.

Learning Outcomes were also seen as problematical as no assessment exists, or in constructivist terms can ever exist, which is capable of definitively ranking an individual's level of learning. In this research, the students' own perceptions of their learning are important. When a student

wrote that she had 'Learnt more in two weeks on placement than in the previous two years', it was unlikely to be literally true but is certainly significant. But what does it mean to learn? Human beings have an innate capacity for learning. Their learning can be merely the acquisition of skills and competences or can, at a deeper level, involve gaining knowledge and understanding which is internal and personal and may change the learner's view of themselves and their role in the world.

Learning is a process of change, growth and development which is historically influenced and culturally specific, comprising what the individual knows, how they think and their very identity. Learning is far broader than knowing about the subject of one's degree; it involves knowing more or thinking differently about all aspects life. Learning involves change and, hopefully, enrichment in identity. However, not all learning is positive and a student may learn, for instance, that Molecular Biology is not for them; although negative, this may be useful (constructive?) to know. On the other hand, some experiences can be mis-educative and I have given examples of students whose placement experiences led them to conclude that no laboratory work was interesting and that all science was a cut-throat business, driven by egoism and the pursuit of money (IR17, IR1).

Analysis of placements as learning opportunities

Much of the longitudinal data confirmed, but did not particularly expand on the data already gained from supplementary studies. Once again students reported higher learning outcomes from doing placement work which they saw as worthwhile than from work which they thought menial or boring. Again the quality of local mediation was variable, with some students reporting good supervision and supportive colleagues while others reported a lack of supervision and antagonistic colleagues. I would, however, like to look further into two aspects of mediation. The first concerns the institutional culture that students experienced in different placement settings and the second concerns the role of the University in supporting placement learning.

Institutional culture

Several placement institutions used by the Department are well respected in their research fields. Given the competition for research funding, it is hardly surprising that some of them had competitive working atmospheres and that this sometimes impacted on placement learning. The longitudinal study provided data from two students who worked in different laboratories within the same department of an American university. The cultures in their two working environments were strikingly different and so too were their learning outcomes:

L20 had no personal contact with his colleagues, and knew nothing of the project or the laboratory, before going on placement (his emails were ignored). His reaction on arrival was that his placement would be 'Enriching and educational' and his project 'Exciting'. At this early stage he enjoyed being immersed in science and felt full of creative ideas. Later he suffered 'Bullying and harassment' from his supervisor and the focus of his activity seems to have become supervisor-appeasement; he worked very long hours in the hope of winning back her approval. The working culture he experienced was dictated by a Laboratory Head who was ambitious and competitive. He liked to pit researchers against each other in the race for results. L20 was told off for sharing results with a lab colleague and his initial creativity was not fostered. After his placement, he saw scientific research as 'Aggressive and competitive' and planned to leave science after graduation.

In complete contrast, L3 exchanged emails with future colleagues before going on placement and felt he already knew them. The lab was 'Welcoming … everyone is very interested in what everyone else is doing' and they shared many social functions. This student discussed problems with colleagues and became immersed in his placement project, thinking about it ('not blindly following protocols'). He suggested, and was encouraged to try, several innovations, made 'Great progress … big achievement … beer at work to celebrate'. His placement work resulted in him being first author on

two research papers. He was offered several PhD studentships with his placement laboratory and elsewhere.

One cannot read too much into these two examples, as there were many other variables than institutional culture, but there were further examples of students being either squashed (e.g. L16) or encouraged (e.g. L19) by the ethos of their host institutions. Longitudinal data confirmed earlier data from the supplementary studies which suggested that institutional culture could, depending on its nature, promote or inhibit placement learning.

University support for placement learning

Presumably one reason why the Department of Biology & Biochemistry provides first and second year practical classes is their belief that such classes provide good foundation for further practical work on placement, in final year projects and beyond. However, one graduate in the supplementary study had said that practicals gave 'Absolutely no useful training for working in a lab' (G2) and students in the longitudinal study complained of feeling unprepared for their placement work: L1 lacked confidence and competence in the lab and L19 wrote 'Most of the things I am doing now I have never done before or done once. I just feel completely useless'. Participants in the longitudinal study made specific recommendations regarding the sort of practical modules which would have helped them and these were fed back to the Department.

Some of the placement-related messages (Mediation) which students picked up from the Department are interesting:

- L1 referred to the fact that arrangements were made for a student to succeed her, without first asking her opinion of the placement, and wrote 'Do Bath care what the placement is like or do they have so many students to place they just want as many options as possible?'.

- When L3 was asked if he felt the Department '*really understood how you had got on, on placement*?' he wrote 'Nobody asked how it was going … not even my tutor'.
- L19 thought the placement team gave little support during placement, 'There was more from you'.
- L20's email, when he was in distress, went unanswered for 'several weeks'.
- Some students (L4, L9, L11) felt that having to pay half fees for placement year was 'Not worth it'.
- Once back at University, students found it 'Funny' (L1) or 'Slightly disappointing' (L3, L20) that only glossy, laminated (and expensive) MCB posters won prizes.

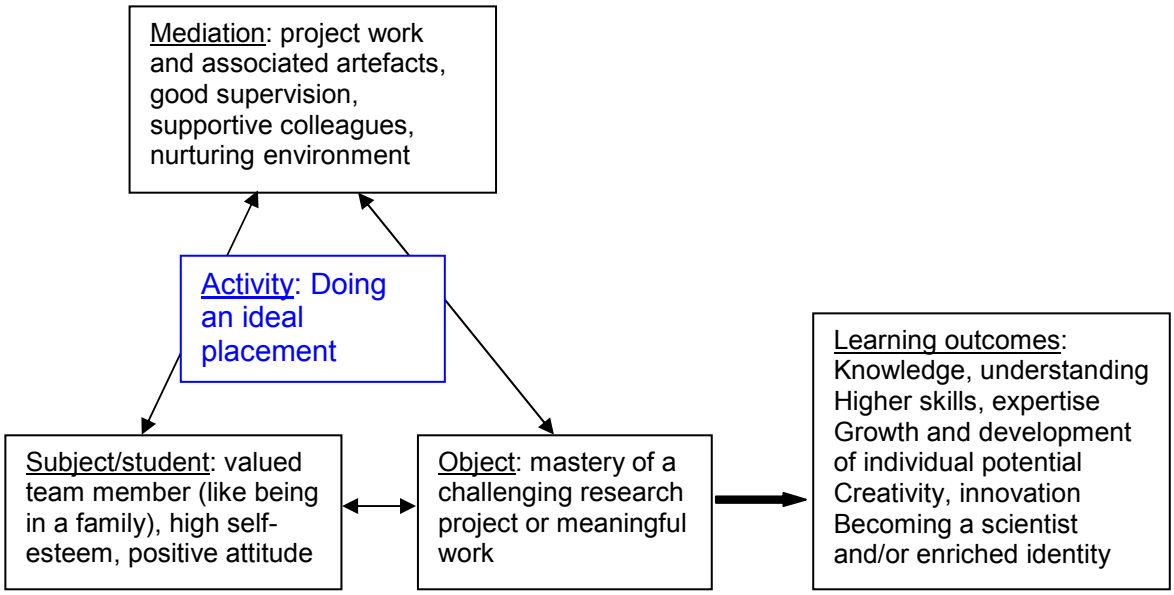
It seems that some students felt that placement provision was about numbers, rather than the quality of student experiences and that, once on placement, they were given little support. Students are invited to keep in touch with the Department while on placement but the placement team is not proactive in seeking student contact. This may have contributed to students feeling under supported and that their fees were 'Not worth it'. Students appeared to feel that awarding prizes to posters with a glossy finish suggested that the Department valued these above un-laminated ones, regardless of scientific content and presentation.

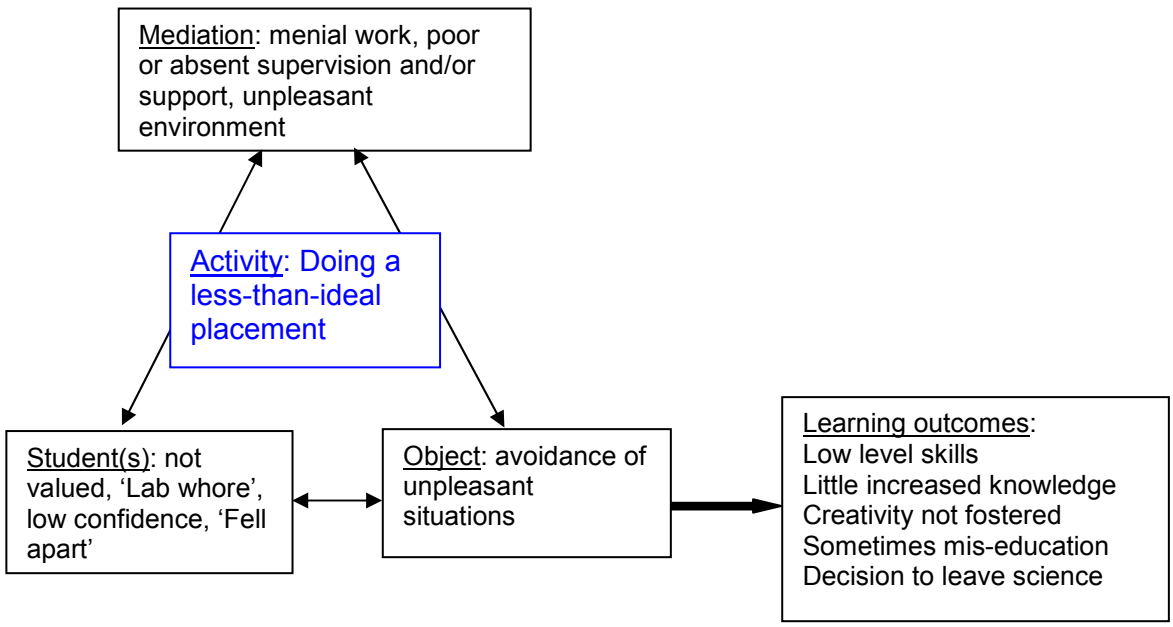
<u>Applying the framework derived in Chapter 5 to placement learning</u>

There appears to be a hierarchy of placement situations which can be described in terms of Activity, Mediation, Learner Individuality and Learning Outcomes and illustrated with contrasting Socio-cultural and Activity Theory (SCAT) diagrams given over the page.

First generation diagrammatic representations of Socio-cultural and Activity Theory.

In the first diagram, the Activity is doing a placement with high potential for learning. In the second, the placement situation is poor in terms of its learning potential.





In reality, of course, most placements fall somewhere between the two extremes illustrated above and are neither perfect nor terrible. In addition, these static representations are misleading as all the categories are dynamic, fluid, changeable and constantly evolving. There are several items worth noting about these diagrams:

Firstly, note that the work a placement student is called upon to do is seen as the Object of the activity when it is work which the student sees as worthwhile; in this case the student engages with it, seeks to understand the background to their work and to perform well (e.g. 'Working on your own project … makes you think through what you are doing and why you are doing it', IR4). In this case the student adopts a deep approach to their placement learning and their learning outcomes are likely to be higher (Marton and Säljö 1976). In a poor placement situation, on the other hand, work which is menial and repetitive is seen as Mediation, conveying a message to the student that he or she is not worthy of meaningful or interesting work; in this case there is 'No motivation to learn anything more about it … You just think "what's the point"' (L17) and, when combined with other negative messages, the Object of the students' activity may become avoidance of their unpleasant situations, examples were boss-avoidance (IR7) and supervisor-appeasement (L20). I seem to have resolved the dilemma I wrote about in the following way in Chapter 5:

> 'When I asked myself *'Which activity are students really engaged in, in practice?'* I sought to discover the focus of the student's attention. Is it, for example, their placement work or boss avoidance? I struggled to decide whether this was actually their Activity, in socio-cultural terms, or the Object of their activity' (p 134).

Activity is defined by the researcher and is, in this case, Doing a placement while the focus of the student's attention, the Object of the activity, is revealed by empirical research and may be the student's work or, say, supervisor appeasement. Further, it appears that some of the terms in socio-cultural theory are tricky to get hold of and that a student's placement work

might be the Object of their Activity and/or Mediation. The work itself seems to convey messages to the student. Menial work carries the negative suggestion that the student is not particularly valued, while challenging work seems to carry a positive message (perhaps 'We believe you are capable of rising to this challenge').

Secondly, note that individual students (as the Subject of their placement activity) had different self-perceptions, depending on whether their placement situations were good or poor, on the nature of their work and the quality of the mediation they received. The research data have provided examples of very varied student identities: L3 was made to feel welcome and valued, he was told by his placement supervisor that he was in the top 5% of students, with regards to his ability and "spark" and was rewarded (beer at work) when his work was innovative and successful. IR2, on the other hand, saw himself as 'Lab Whore' when performing mundane chores for an hourly fee and L20 began by feeling enriched by his placement but later said that he lost confidence and fell apart when bullied on placement. It seems that Barnett was correct when he referred to 'The fragility of being a student' (2005).

Finally, note the links between the Object of an activity and its Learning Outcomes. The Outcomes follow logically from the Object of the activity, in the sense that a student who engages actively with their placement work is likely to achieve higher order learning outcomes than one who concentrates on boss-avoidance or supervisor appeasement. This shift in the Object appears to stem from the type of Mediation which the student perceives; Mediation can be positive or negative, constructive or destructive of confidence, self-esteem or happiness. Unsurprisingly, students seek to avoid situations they find unpleasant and, as a consequence, negative mediation and situations where students feel distressed tend to result in lower learning outcomes. This can be doubly unfortunate for the hapless student whose placement is judged by their university Department, not according to the learning potential of the placement situation itself, but by the quality of its measurable "outcomes" which, in this case, are the placement report, post-placement interview and poster presentation. In order to achieve worthwhile

learning outcomes, it is therefore essential to ensure that the Object of the student's activity is appropriate for learning.

Research questions answered?

Does this brief analysis of the data on placements provide further answers to the research questions on the nature of placement learning and how it might come about? In Chapter 5, I modelled the processes involved in placement learning and discussed its promoters and inhibitors but concluded that the nature of placement learning depended on the *potential* for learning in the placement situation. Learning potential comprised the nature and quality of learning Activity and the Mediation available to the student, including their supervision and the culture of the placement institution; mediation from placement culture has been expanded upon here and mediation from the University has been added.

Of course, the student too has his or her own potential for learning, influenced by their innate ability, perspectives and emotions. While their ability may be immutable, how they are cast in each learning situation seems to be very variable; they may be valued team members or not valued, may have high or low self esteem and positive or negative attitudes. It is hardly surprising, therefore, that their Learning Outcomes vary widely too.

In an ideal placement situation (where a challenging and worthwhile project is provided, with good supervision amongst colleagues in a supportive atmosphere) the student is likely to engage with their work and to attain a high level of learning and personal and professional development. In a less-than-ideal placement situation (where the work is menial, supervision poor or absent, the atmosphere negative and support from university staff luke-warm or absent) the student's Object of activity is likely to become avoidance or amelioration of their unpleasant circumstances. As a result, their learning is likely to be lower level acquisition of skills and little increased knowledge, even mis-education.

It seems that the socio-cultural and activity theoretical approach to placement learning has been informative but that the framework for analysis which asked about students' learning Activity needs to be revised and to consider, instead, the Object of their activity. There is another shortcoming in the framework; it fails to address the occasional disparity, revealed by the data, between the learning outcomes reported by students and the learning which the University anticipated would result from placements.

'The University anticipated' is an odd phrase. It treats the University, which is a corporate body, as a single entity. Is it appropriate to think in these terms? Argyris and Schön extended their work on individuals to cover the behaviour of organisations and considered their Theories of Action. Grisoni (2004) suggests that these concepts may provide a useful way of comparing actual and theoretical undergraduate learning situations.

On individuals, Argyris and Schön wrote:

> 'When someone is asked how he would behave under certain circumstances, the answer he usually gives is his espoused theory of action for that situation. This is the theory of action to which he gives allegiance and which, upon request, he communicates to others. However, the theory that actually governs his actions is his theory-in-use, which may or may not be compatible with his espoused theory; furthermore, the individual may or may not be aware of the incompatibility of the two theories' (1974, p7).

They went on to state that organisations, too, have 'Theories of action … espoused theories which they announce to the world and theories-in-use which may be inferred from their directly observable behaviour' (1978, p 11). 'It is individuals who decide and act, but [in organisations] they do these things *for* the collectivity by virtue of the rules for decision, delegation and membership' (1978, p 13). Note that individuals and groups may be *unaware* of the disparity between their espoused theories and the actual situation in practice.

All data detailed so far have come from empirical research into participants' lived experiences; they are informative on theories-in-use. In order to discover the theories espoused by the Department and the University, published data must now be introduced into the analytical equation. Published data are important not for better understanding how, or under what circumstances, students learn but rather *why* they sometimes learn surprisingly little, in situations which are intended to deliver high learning outcomes. In order to examine this I asked myself 'How did the Department or University claim to act?' as well as considering how it acted in practice, as experienced by students. In short, 'Did the University actually do what it said it was doing?' or 'Was it delivering what it believed it was?'

Sometimes espoused theories are clearly stated but occasionally they have to be inferred or even, as in the case of practical classes, guessed at (see forward). From now on I shall consider the Objects of each activity which seem to be espoused by the Department of Biology & Biochemistry or the University of Bath and compare these with the Objects which students reported engaging in, in practice. Secondly, I shall consider the support for learning which was espoused, compared with the support that students experienced in practice and the messages which were espoused by the Department or the University and those which students actually experienced; by 'messages' I mean the (often subtle) clues to a situation, and students' roles within it, which can impact on their learning. Messages and emotional support are forms of semiotic mediation. Adding this to the analytical categories may be a useful way to examine disparities between expected and actual learning outcomes, the 'target' and 'personal' understandings (Entwistle and Smith 2002) of undergraduate learning. The analytical framework used in this chapter, based on a marriage between Socio-cultural and Activity Theory and Theories of Action, is given over the page.

Analytical framework based on a marriage between Socio-Cultural and Activity Theoeries of Learning (see Vygotsky 1978; Engeström, Miettinen and Punamäki 1999; Daniels 2001) and Theories of Action (Argyris and Schön 1978):

- Object of activity (related to goal, purpose, motivation)

  What is the Object of activity espoused in a learning situation and what is the real Object of student activity, in practice?

- Mediation (related to emotional support, support for learning, direct and indirect human interactions, language, texts, signs, tools, psychological tools, cultural ethos). The medium and the message

  What support is espoused in a learning situation and which messages do students actually experience?

- Learner individuality (related to innate ability, attributes, personality, background, experience)

  What are the perceptions and reactions of individual students to their learning opportunities?

- Learning outcomes

  What effects do the factors listed above have on the nature of the learning reported by students?

There is, inevitably, some degree of overlap between categories because of the complexity of any learning situation but now, at last, I have a framework which may be adequate to the task of analysing undergraduate learning at programme level.

Placement learning: espoused theories and theories-in-use

The last piece of the jigsaw, in my analysis of placement learning, is a consideration of the theories which are espoused for placements. The University has corporate membership of the Association for Sandwich Education and Training and, by inference, espouses theories implicit in ASET's Code of Practice (2001) referred to in Chapter 1. In addition, university departments are subject to review by the QAA and are called upon to demonstrate that their placement schemes meet certain 'precepts' (QAA's Code of Practice 2001). Placement theories espoused under the two codes relate to work experience for the acquisition of skills for use in employment and include the University's responsibility for placement learning and the appropriateness of learning opportunities, for student health and safety and for student support during placement.

The Department of Biology & Biochemistry's webpage (2005) stated that these 'Periods of professional work experience provide our students with the confidence and research expertise that they need to go out as Bath's standard bearers into the world of biological work. The superb employment record of our graduates is a testament to the success of the Bath "sandwich" system'. The theory espoused here is that students gain confidence and research expertise through their placements. Interestingly, it seems that successful placement students are also seen as 'standard bearers' for the Department; this seems to suggest that placements make a special contribution towards the high standard of the Department's graduates on entry to employment and contribute towards the Department's high reputation. Interestingly, the academic value of placements may not, however, be fully realised since the Placement Officer does not report to an academic. Academic staff have delegated responsibility for this year of the MCB programmes to an administrator.

The data have shown that students' experiences are sometimes compatible with espoused theories; several students in both the supplementary and the main, longitudinal studies experienced the type of placement work which led

them to acquire skills which were likely to be of use in future employment. Sometimes, however, theories-in-use fell below those espoused and the result was unexpected. For example, L20 did not gain confidence but lost it: he 'Fell apart, was in a mess'. What is more, the Department did not support this student in his distress. Initially they did not know of his difficulties as he was reluctant to approach them and they were not proactive in finding out (e.g. 'Nobody asked how it was going', L3). When L20 eventually did email the Director of Placements, he had to wait several weeks for a response.

Further instances where placement theories-in-use appeared to fall short of espoused theories, and where learning outcomes were consequently lower than those expected, included: L11 had 'disorganised' supervision and work which was 'Pretty dull! I haven't felt at all challenged', L15 learnt 'Nothing new except machine work which I wouldn't ever use again', L16 was 'Not very satisfied. Almost exclusively doing one automated method … no supervision', L17's work was 'Very mundane. I haven't really learnt anything' and so on. However, there were also instances where learning outcomes may have *exceeded* expectations. L3's placement seems to have set him on his way to a promising research career (above) and there were further examples in the supplementary studies:

- One graduate, now a postdoctoral research scientist, looked back on her placement as 'STUPENDOUS' and 'Undoubtedly the best aspect of the whole degree - absolutely invaluable. Without it - I'm not sure how good a scientist I'd be' (G9).
- An undergraduate who is now a postgraduate student wrote 'I gained a true insight into the professional world of science' but went on to write that she 'Gained most personally … most amazing experiences and met wonderful people' (IR4).
- Another undergraduate was also influenced personally by discovering that science was 'By no means always honourable and selfless … driven by money and its pursuit' and concluded that she wanted to work in medical research with 'Direct(!!!) relevance' for patients' (IR1, original punctuation).

- And another, who learnt not from his working but from his social life on placement, ‘Grew ten years in experience and maturity … Really discover[ed] myself … facilitated by people I met with more life experience, who were more cultured, more intelligent and quite inspiring’ (IR17).

These data are about rather more than the acquisition of skills. They are about transformational learning and personal development, about changes in students’ perspectives of themselves as individuals and their relationship with the world, about moving towards realising their full potential.

In conclusion, learning outcomes from placements may differ from those anticipated. When the work, supervision and other mediation fell short of that which was espoused, then learning outcomes were lower than expected but when the placement situation was full of learning potential, when it was ideal in terms of work and mediation, and when the student also had high potential, then the learning outcome far exceeded expectations.

Findings on placements

Placements in this study were very variable in nature and quality. Some involved research projects which students found engaging and some involved mundane, repetitive work which students found dull. The quality of supervision and the working culture sometimes provided a nurturing environment. In other examples, the social situation was poor and inhibiting of learning and creativity. The learning outcomes were very variable too; when placements provided low potential for learning, some specific skills were acquired (some of the MCB-related or generic work-related skills listed on page 92) but little other learning. When placements had high potential, and the students had high ability, the learning was significant. It seems that a good placement can transform a novice into an expert and may have transformational effects on the student at a deep personal level. Good placements had the potential to enrich student identity.

The data outlined in the Tables of Placements (Chapters 4 and 6) suggest that, of the 59 placements studied, 29 (49%) were high quality learning opportunities and were beneficial to student learning, 9 (15%) were adequate and 21 (36%) were poor with regard to learning potential and resulted in the student learning relatively little from their placement. These figures surprised me. When I was Placements Officer I believed that very few of the Departments' placements were of poor quality but, when viewed from the students' perspectives, as many as 36% may contribute little to learning. I was *unaware* of the disparity between the theories I espoused as Placements Tutor and theories-in-use as experienced by our placement students. Although my approach was student-centred, my practice (and that of my colleagues) was not informed by sufficient high-quality empirical evidence. I used to think of a good placement as one within a prestigious institution or successful company, rather than one which could provide high potential for undergraduate learning, and did not fully realise the importance of worthwhile placement work, good supervision and a supportive culture.

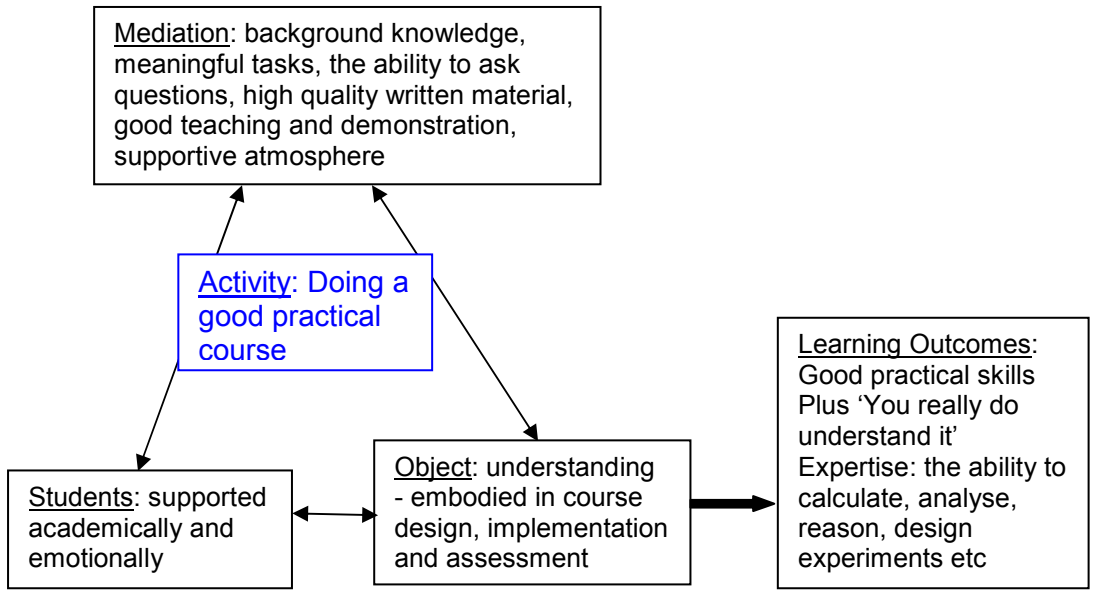
It seems that taking an evidence-based Socio-Cultural and Activity Theoretical approach, coupled with consideration of Theories of Action, can lead to a different understanding of placement learning. In the next section, the same analytical approach is applied to university-based learning opportunities.

Analysis of university-based learning opportunities

Analysis of practical classes

I chose to analyse practical classes ahead of other university-based learning situations because they seemed most similar to placements insofar as both involve students in laboratory-based practical work.

The data on practical classes are varied and can be summarised in first generation SCAT diagrams representing practical courses with high (top) and low (below) potential for student learning:



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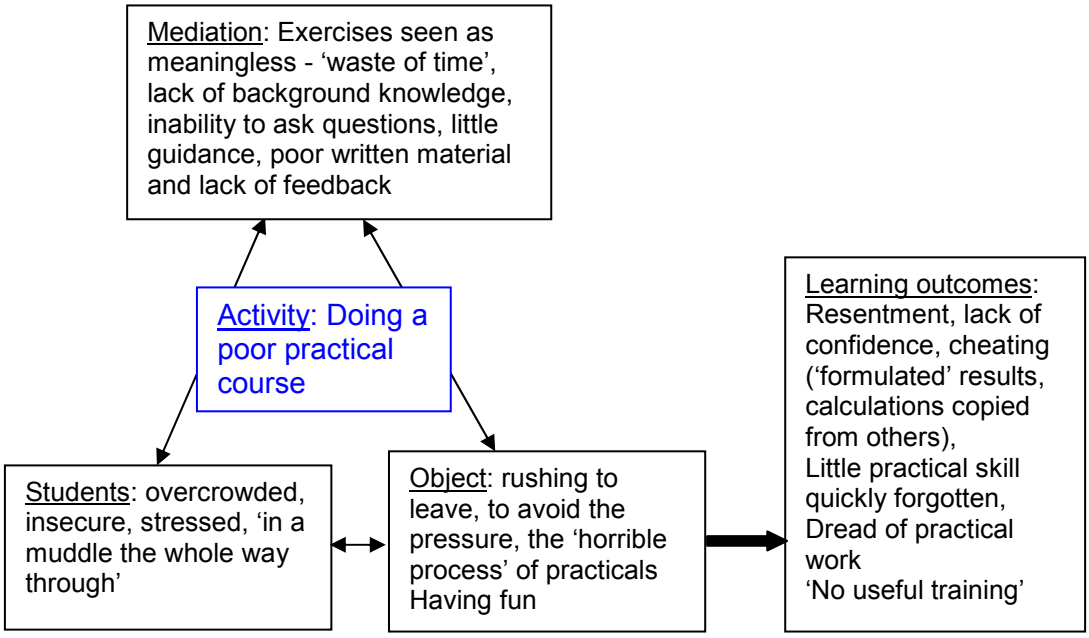


As with placement learning, note how the Object of practical classes varied dramatically and seems to have had a direct influence on the Learning Outcomes reported by students. When students' attention was focussed on understanding, this was indeed achieved 'You really do understand it' (L3). All too often, though, students seem to have disliked practicals and to have rushed to escape from the lab: 'The general gist of practicals is that everyone hates them and does them as quickly as possible … no-one cares what they do' (L22) and 'We don't learn any more by having to rush through lots of exercises, we just get stressed and resent having to do them!' (L25).

The way students felt about practicals seems to have had a major influence on their Object of activity. Class numbers were 'A bit of a shock … feel a bit pressurized … panic' (L1). The pressure students felt did not appear to stem from their previous experiences of school practicals where 'There was a lot more space, a lot more time and it wasn't a rush' (L4) but neither, I believe, were students actually short of time (I remember students leaving practical classes well before they were scheduled to end), therefore some other aspect(s) of the university situation must induce stress. Once again it seems that students wanted to escape from situations they experienced as unpleasant, where they felt stressed and insecure, undergoing a 'horrible process' (L23).

Mediation influenced how students felt about their practical courses. Good courses provided support for students' learning and emotional wellbeing. Poor or absent mediation, though, left them feeling 'Scared to ask' (L23), 'In a muddle all the way through' (L3) and not knowing 'What the hell I'm doing' (L2). Provision of feedback on practical work would have been helpful but was often lacking.

The fact that 1998 graduates reported having the same Object ('The main aim would be to leave as quickly as possible', G9), receiving the same level of Mediation ('Often fumbled our way through with little guidance', G6) and feeling the same way, as Subjects ('Used to dread them', G9), as students who graduated in 2004 or 2005 strongly suggests that the Department may

have been wasting its resources for a considerable period of time on practical courses which may have had little learning potential.

Learning outcomes also varied with the individual and, although the majority of data on practicals were somewhat negative, some students reported finding them 'A lot more fun than lectures' (G4), 'Quite a good laugh' (G5) and 'The best part of my week' (L5). These students may have enjoyed the social aspects of laboratory classes, where they worked in pairs or groups. If their Object was having fun, their learning outcomes are unlikely to have been high.

As mentioned earlier (Chapter 6), I interpret students' different responses to learning situations (e.g. practical classes were disliked by most but seen as fun by a few) in the following way: I believe that the majority or consensus view is informative about the learning situation itself while the deviant views of some individuals are more informative about those particular students. [The Department's usual method of collecting student feedback, using lottery-type cards and automated production of quantitative data, is not informative in this regard.]

Of the 1998 graduates who responded to my request for data, 70% were critical of practicals and these were the ones who went on to postgraduate studies or work in scientific disciplines. Did they perhaps have a genuine interest in practical laboratory work and, if so, were they particularly disappointed at their inability to learn from practicals? Certainly they had had time to reflect on the usefulness or otherwise of their university practical courses in the work they did subsequently as postgraduates or employees.

The espoused theory behind practical work is not easy to track down and 'Very little justification is normally given for its presence today. It is assumed to be necessary and important' to science degree programmes, even though 'It is quite common to hear [students] say that laboratories are boring, that they go through the motions of experimentation without stimulation and often without clear purpose' (Boud, Dunn and Hegarty-Hazel 1986, p 3). However,

the presence of “demonstrators” suggests an espoused theory of learning through observation of experts ‘demonstrating’ procedures, before practising the techniques involved. The provision of laboratory booklets and protocols, suggests that the Department espoused support for student learning. By implication, therefore, espoused theories for practical classes involved learning from the booklet, learning by doing and perhaps learning through discovery with the aid of more capable demonstrators, acting as mediators. In addition, the Department seems to feel that high numbers are a good thing when it comes to laboratory teaching as the Introduction to the Department of Biology and Biochemistry on its webpage (2005) drew attention to the fact that their ‘New teaching laboratories can accommodate up to 180 undergraduates and provides the largest facility of its type in the University’.

Findings on practical classes

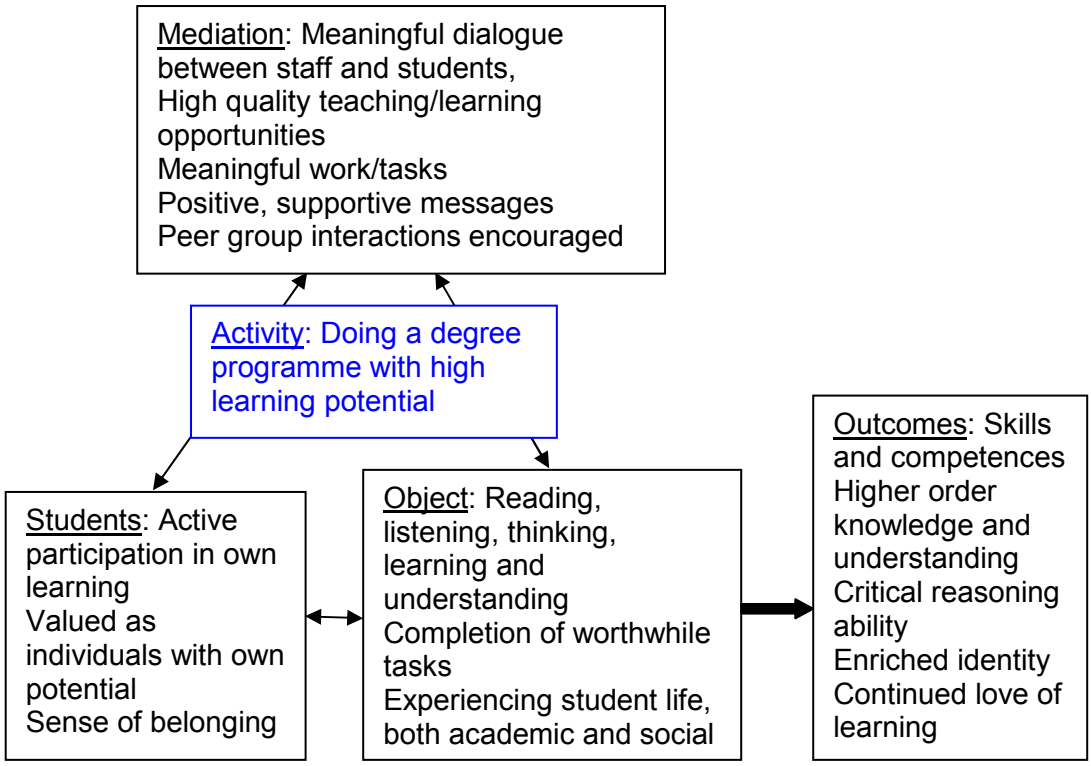
It seems that practical classes were an area where there was often great disparity between espoused theories and theories-in-use. From the Department’s point of view, it may be a good thing to have enormous laboratories but, in practice, students dislike large class numbers and find them stressful. Demonstrators who do not usually demonstrate are unhelpful for learning. Also, the comment that students ‘Don’t learn any more by having to rush through lots of exercises’, but instead become stressed and resentful, strongly suggests that students might benefit from doing fewer but better practicals.

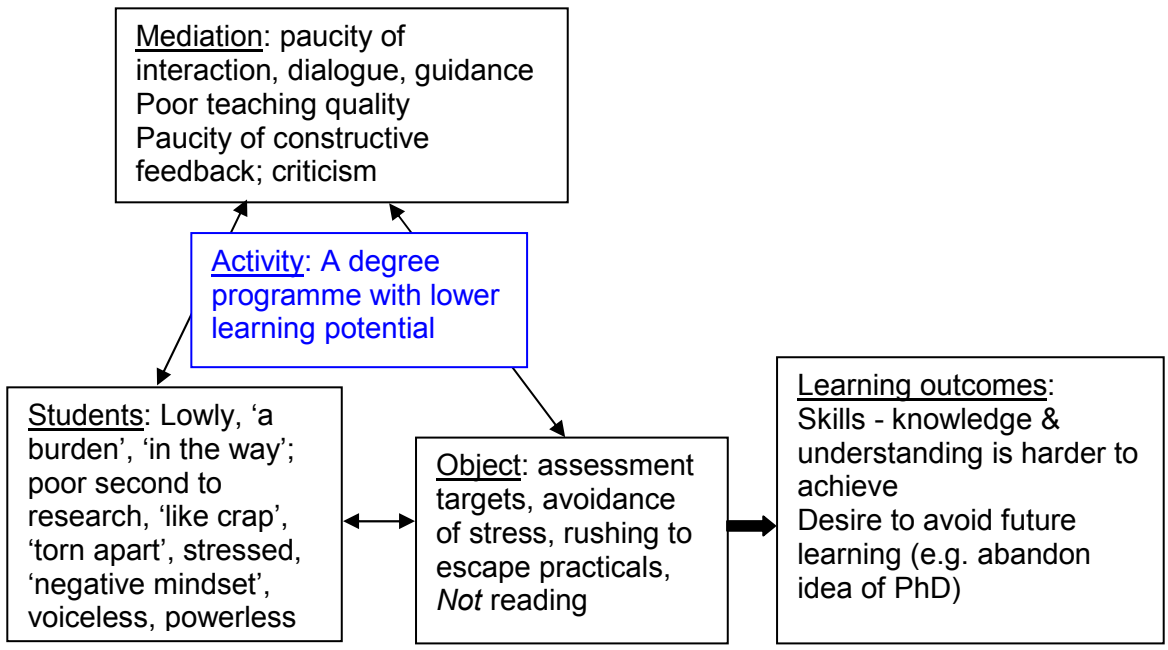
It appears that the Department’s resources were being expended to little effect. What is more, this situation had existed for many years, at least since 1994 when Group G participants joined the Department. Given that departments are reluctant to waste limited resources, I have to assume that Biology & Biochemistry see greater value in practicals than my analysis suggests, perhaps because their own data or analyses are different. There were, though, examples of good practice, where practical classes were of high quality and where student understanding was achieved; unfortunately, this good practice does not seem to have been disseminated throughout the Department.

Analysis of other university-based learning opportunities

It would be possible to analyse lectures, tutorials, student seminars, projects etc individually and to construct SCAT diagrams for ideal and less-good examples of each. However, for brevity, the following analysis considers university-based aspects of 'Doing a degree' in its entirety. Analysis begins with contrasting SCAT diagrams (over the page) of an idealised degree programme and one based on empirical data indicating some shortfall in learning potential.

Contrasting SCAT diagrams of an idealised degree programme with high learning potential (top) and (below) with empirical data suggesting some shortfall in learning potential:





The two SCAT diagrams, illustrated above, are very different in many respects. There is considerable disparity between the idealised degree programme, with high learning potential (top), and that which draws on empirical data from students (bottom). Might these diagrams reflect disparity between the theories of action espoused by the University and its Department of Biology & Biochemistry and their theories-in-use, as experienced by students?

What are the theories espoused for learning and teaching within the University? The Introduction to the Department of Biology & Biochemistry on its webpage (2005) began by describing the Department as 'A vibrant and ambitious research-based Department'. It went on to state 'We are proud of our success in research. At the same time, we are also determined to continue providing first rate teaching to our undergraduate programmes'. A University of Bath webpage (2005a) explained what was meant by 'first rate teaching', i.e. getting top marks for teaching quality in a QAA subject review: 'It means that [the Department] achieved the maximum of four out of four in all six categories covered by the review. These are:

> Curriculum Design, Content and Organisation
> Teaching, Learning and Assessment
> Student Progression and Achievement
> Student Support and Guidance
> Learning Resources [and]
> Quality Management and Enhancement'.

The MCB degree programme specification (Appendix 1) gave, as the Department's primary educational aim, to 'Offer a stimulating environment that will encourage students to develop their full academic potential'. Under 'Intended learning outcomes' it went on to state that 'Students are encouraged and supported in developing an independent learning style to maximise their academic performance and enable them to take advantage of lifelong learning opportunities'. The University of Bath Learning and Teaching Strategy also placed emphasis on 'A progressive shift to more

independent, supported learning as students advance through their programmes of study' (2005b, p 3).

The messages espoused seem to be:

- that research is valued above teaching, i.e. it is the Department's primary activity
- that teaching is "first rate" and should continue as it is
- that students are amply supported while they become independent learners and
- that students are likely to take advantage of lifelong learning opportunities.

Theories-in-use in lectures, tutorials, student seminars etc are considered below.

<u>The Object of activity in other university-based learning opportunities</u>

A major component of teaching these MCB programmes (and many others) remains the lecture course. As learning opportunities, lectures often fall at the first fence in the sense that they may be based, not on a constructivist view of learning, but on the old paradigm, whereby knowledge was thought to be substantial and 'out there', acquired by experts and transmitted to learners (see Ramsden 1992, pp 111-118). The lecturer who students criticised for covering 'Everything there was to know on enzymology, with like 60 slides' (L12) seems to have held this view; the Object of his lecturing activity seems to have been to download massive amounts of information. When the epistemology and pedagogy are inappropriate to current understanding of learning processes, it is reasonable to wonder whether the teaching can be successful. One student demonstrated his tacit awareness of the constructive nature of knowledge when he criticised the mis-use of PowerPoint as like 'Adding the lecturer's notes to the student's notes without passing through the brain of either' (L3); he recognised that lectures should engage his brain.

The Object of students' activity in lectures should ideally be learning-related and participants in the longitudinal study did occasionally mention listening, thinking and understanding (e.g. L3, L10). Often, though, they were less involved in thinking than in capturing a full set of notes and/or discovering what they needed to revise in order to pass exams (e.g. L9). A number of lecture subjects were seen as irrelevant ('Waste of time', L10 and 'Not really pertinent' L25). When students failed to see the relevance of a subject they were, of course, less likely to be fully engaged with it.

Graduates in the supplementary study agreed that some subjects were a waste of time but, when asked the general question '*Did you learn a lot from lectures?'*, they all said yes and most added that they probably learnt more from their own work subsequently, with notes, textbooks and references. One graduate wrote that 'It helps in giving you a framework' (G2). G5 wrote 'It's important not to get too bogged down in the little details that can be irrelevant and to get a grasp of the whole picture! This took me a good 6-7 months to come to terms with. Also very often the lecture will only be the bare minimum of the subject and, to really understand it, you will have to go and do further reading. This took me half of my first year to come to terms with!' After a while, but not initially, the Object of lectures was seen as grasping a framework, or the whole picture, as the background for individual study. Participants in the longitudinal study also valued private study but stated that 'They conspire to stop you reading up on lectures, there's so much else to do' (L1) and that project work 'Pushes some of my studies away' (L3).

Tutorial work sometimes had relevance for students, and encouraged them to read around their subject and to become 'Absorbed in it' (L3), but sometimes seemed unrelated to the rest of the course (L4) or of interest to the tutor but not the tutees (L9); under these circumstances the Object of student activity might have been completion of tutorial assignments, but without real engagement.

Some students saw their final year projects as worthwhile and seem to have engaged with them as the Object of their activity: 'I've got a bit more purpose at the moment, with my lab project' (L25) and 'I find myself getting a little bit excited when I know I'm going to get a result' (L24). These comments are very similar to ones students made about some placement work. Others thought 'It wasn't really that relevant to any of the other modules' (L22).

Mediation in other university-based learning opportunities

What support and which messages did students actually receive as undergraduates? The data given above demonstrate that research participants had not been prepared for university by their school education and were not taught study skills at university (although there may have been an optional unit). Without this support (Mediation) for their lecture-based learning, it took some participants considerable time ('6-7 months', G5, and 'About a year', L24) to comprehend the point of lectures and to learn from them. Also, without study skills, students did not initially know how to revise; L3 said his second year revision was better than his first as he had learnt how to 'Actively get it into your brain instead of just sitting there reading it from a book'. Even in their final year students lacked sufficient support and, before their seminars, were stressed at the mere thought of having to present 'In front of a class of sixty' (L22), 'I'm just so scared' (L17). 'I've never done a presentation before, not even in tutorial' (L23) and 'They could have eased us in a little more gently' (L22). On final year projects: 'Didn't really know what I was doing to start with' (L2) or felt 'Chucked in there' and found the experience 'Nerve-racking' (L22)

Dialogue is the most natural and direct form of socio-cultural mediation but dialogue between staff and students is particularly difficult in lectures with huge class numbers. Students reported an absence of discussion or interaction and linked this with a lack of motivation: 'It's one of the hard things of coming to university … you've just got one lecturer between hundreds so there's no interaction, there's no motivation. Some of them do say "Ask questions" but, when you're in a lecture with 150 people, you don't stick your

hand up' (L1). Second year students felt 'Less isolated' in slightly smaller groups and that lecturers 'Probably recognise you and it feels a bit more friendly, more interaction' (L9). The shortcomings of large classes could, however, be overcome to some degree by staff enthusiasm (L9) and by staff seeming to care (L12).

Good teaching (effective, positive Mediation) involved having well-planned lectures, getting the pace right, the provision of handouts with key points (rather than detail) such that students had to make their own notes, and recommending a few good references. When the pace was too fast, so that students were writing all the time, they 'Cannot take in what the lecturer is saying' (L10), and when they were given a complete set of notes as handouts they were 'Not really paying attention' (L5).

As mentioned above, the mis-use of PowerPoint was associated with poor lecturing technique because 'It's basically like adding the lecturer's notes to the student's notes without passing through the brain of either' and 'It just keeps your attention so much longer if somebody's actually speaking to you rather than reading … it's their own words' (both L3) and 'Just reading through doesn't keep my attention' (L9). Students said they had never been consulted about the use of PowerPoint, which they thought less useful than chalk and talk, whereby lecturers are restricted to note-taking pace and to hand-drawing diagrams, such that students can watch them being constructed; these were seen as better than complex diagrams taken from papers (L12). Interestingly, the Director of Teaching had been urging academic staff to use PowerPoint and the web but experienced professors had been told by students, as I had, that they preferred chalk and talk. Why, I wonder, are innovative methods being encouraged when student-based evidence is against their introduction?

Tutorials had the potential to provide dialogue between staff and small numbers of students. However, supplementary studies had suggested that graduates saw tutorials as 'OK but not particularly useful' (G2). Data from

the longitudinal study was varied: tutors sometimes engaged in useful dialogue with their tutees, supporting them academically and emotionally: 'He asks us what other work we've got and adjusts [tutorial work] for when we have time. He even let us change our essay title if we didn't think it was good enough … that was very good. Then we went out for a drink with him yesterday, about eight of us. He really seems to care what we do, how our work's going' (L3). Sometimes, though, tutors 'Talk[ed] at us rather than with us' (L8) or were simply too busy to talk to their tutees; L22 had to book an appointment to see her tutor 'Two or three weeks in advance, no good to me, he's meant to be there … if I've got a problem I need to talk to someone, he shouldn't have a tutor group because he is Head of Department'.

Textbooks (Mediation) were said to be variable. E.g. *Molecular Biology of the Cell* (Alberts et al 2002), was good but there was no need to have bought the companion volume. A statistics booklet 'That was "essential to buy" is rubbish!' (L8). Recommended background reading, in the form of reviews and research papers may have been of high quality but of no benefit to those who gave up reading during periods of excessive stress 'Because I don't have time to do it. If I tried to do it, I would stress myself out' (L25, L24).

Feedback is an obvious form of Mediation and is dealt with later. The final example of Mediation dealt with in this section concerns non-verbal communication: One non-placement student said of her final year project supervisor 'I can see his face just falls when I knock on the door' and 'I don't like being in there at all … you're in the way' (L22).

<u>Students as Subjects of university-based learning opportunities</u>

The identity of students, as the Subjects of degree programmes, was very variable. Some recognised (but probably not in their first year) the need to be active participants in their own learning. A sense of being valued and of belonging was mentioned by placement students but was not mentioned with regard to the Department or the University nor, until the final year, with regard to MCB undergraduates as a peer group. On the other hand,

students did mention feeling like ‘Lowly undergraduates … a burden … not important’ (L25), ‘Like crap’ (L17) and ‘Torn apart’ (L1).

Students seem to have varied in their need for emotional support. L1 wanted a non-judgemental ‘Whinging outlet’ and L25 appreciated the opportunity to get ‘Stuff off my chest’ and referred to it easing his passage through a stressful final year. In both these cases, the chance to whinge came not from university-based opportunities but from participation in this research. The opportunity to say what they found positive (‘more purpose’, ‘happier’, ‘excited’) was also, of course, provided.

Findings from university-based learning opportunities

Empirical data suggested frequent disparity between the theories espoused for learning and teaching and those experienced by MCB students at Bath. In particular, the teaching they received may not always have been ‘first-rate’ and the support they received, both support for learning and emotional support, may not have been adequate. The university may not always have been doing or providing what it claimed to be and may have been unaware of the situation experienced by their students.

Some undergraduates took a long time to perfect their study techniques and this may have reduced their ability to learn from lectures initially. Some subjects did not engage students and were seen as ‘A waste of time’, or not relevant to MCB by both the 1994 intake (G1) and the 2001 intake; it seems that the Department may have been wasting its time, effort and resources for a long while in respect of certain subjects which had little relevance for MCB students.

High class numbers reduced the opportunity for dialogue between staff and students by preventing students from asking questions; interestingly, the first of Chickering and Gamson’s *Seven Principles of Good Practice in Undergraduate Education* (1987) was the encouragement of contact between students and faculty. Personal interaction may be impossible in huge

classes, but the closer the teacher-student relationship *approximated* to natural dialogue, the more likely it was to result in learning. Students wanted lecturers to have enthusiasm for their subject and preferred smaller classes because they were friendlier and students felt less isolated. Participants explained that their preference for chalk and talk lectures was because 'Somebody actually speaking to you rather than reading … it's their own words. You can concentrate more'. It seems that traditional lectures, when they are done well, can successfully fulfil two functions; the first is that of 'economically and influentially provid[ing] structures of understanding' for students (Tharp and Gallimore 1988) and the second is that of providing enthusiasm (inspiration, perhaps?) which students can take to their own studies of the subject.

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So far, I have considered specific learning situations (placements, lectures, practical classes etc) but not programme-wide influences on undergraduate learning. Since students reported that workload, assessment and feedback all impacted on their learning, either positively or negatively, these matters are considered next, before considering the Learning outcomes from degree programmes.

Analysis of programme-wide influences on undergraduate learning

<u>Workload</u>

Participants did not mention their first year workload but second year involved a 'Big jump in workload' (L9), 'It's stress [when] the priority is either finish your coursework before the deadline or do some background reading. You'll always do the coursework' (L3) and 'They conspire to stop you reading up on lectures; there's so much else to do' (L1).

Stress from second year workload was compounded by that caused through students having to commute to campus and by a timetable that was difficult

for them in two respects: they had ‘Lots of little breaks’, which they felt forced them to waste time, and there was so much ‘Crammed in before Easter’ that students felt tired from ‘Literally running from one practical to the next and to the next lecture’ (L9, L12, L16). ‘When I came to revise some of the stuff that was taught before Easter, I couldn’t actually remember very much at all’ (L12).

Final year workload was higher still, especially in one semester, with projects occupying students almost full time. BSc students, did their projects in the first semester and Masters students in the second and, as the optional units which students found most interesting were in semester one, this arrangement resulted in BSc students having a particularly heavy workload. They found this ‘Very stressful’ (L12, L11), ‘I haven’t got time to breathe … feel like I’ve got too much to do’ (L22). Even Masters students found that the amount of time spent on the project ‘Pushes some of my studies away’ (L3).

The amount of background reading contributed to students’ final year workload, e.g. for Genes and Development ‘Loads and loads of papers for each lecture’ (L9), for Neurochemistry ‘A reference of seven chapters to read for one lecture [plus] two other references approximately 40 pages’ (L22). In addition, some students found research articles ‘Inaccessible’ and confusing (L24). In response to the high number of references some students gave up background reading altogether for a while ‘Simply because I don’t’ have time to do it. If I tried to do it, I would stress myself out’ (L25). Students preferred to have fewer references, as in Neuro-development where, for every two lectures, handouts listed ‘5 or 6 reviews which he recommends you should read, together with some non-compulsory primary papers’ (L12).

Overall workload gave some students a sense of ‘panic’: ‘In the first three days I was set nine tasks and that was just scary’ (L22), ‘It was hard to cope, anxiety mostly’ (L3) and ‘Snowed under, overwhelming’ (L12). The data contain only one incidence of a student who, although she wrote ‘This semester has been tough’, felt ‘Quite calm … disciplined and efficient about the workload … all about time management’ (L9).

Assessment

Assessment is always a thorny issue. Employers need some way of selecting the best students and universities have to assess them. Also, exams can be motivating as students learn/revise for exams, when the results count towards their degree classifications (e.g. L11, L22).

In this study, exams seem to have worried students more when they 'Had no idea what was expected' of them and no model answers to guide them (L4, L9). This was true of first year exams but also some final year exams; Masters students had no idea what would be expected of them in an Integrated MCB exam; the Director of Teaching had agreed to talk to them about it but 'After Easter [and that] may be too late for revision' (L17).

After the first year, students preferred exam questions which tested their understanding and required them to integrate several topics. Some second year students, though, thought 'Everything we have done so far is learning and regurgitating in exams' (L1) and 'Exams are more a test of how much you can write in a certain amount of time than they are of your ability ... a race for who can write the quickest, rather than who is more knowledgeable' and that it would be better if second year exams were two hours long, to familiarise students with the format of final exams and to avoid 'The ridiculous situation … where you have an hour to cram down as much as you [can] (L25).

Poor exam results (i.e. exam failure) sometimes acted as an 'Assault on personal confidence … helping to create a rather negative mindset, which I retained for the following 2 years!' (L25). Some students on the Masters programme struggled with their Critical Reading exam because the questions were based on a book which they found 'So hard' (L17) and where they did not understand the questions (L1, L19); this exam caused distress, with L19 in tears and L1's low mark making her feel that she had 'A huge mountain to climb'.

An example of assessment which did not involve exams was provided by Practical Molecular Biology, in which students were assessed on their workbook and interview. Interviewers enquired about the practical classes in terms of 'What does this mean? What happens here? Why? Why did you use these controls?' (L9 and L12). The result was that 'When you leave you really do understand it' (L3).

Feedback

Students frequently raised the matter of feedback but it was often the absence or lateness of it they mentioned with regard to exams, practical work, tutorials and distance learning. 'If you get it at all, it's usually late' (L9), and '[The Director of Teaching] forgot to send any feedback at all' (L3). When L1 received no feedback from her tutor on either an essay or a presentation, she said she felt capable of writing a good essay but had no guidance to enable her to improve.

Negative feedback (as provided following some seminar presentations) may have been worse than an absence of feedback as it 'Made us all feel like crap' (L17), 'Torn apart' (L1).

Students appreciated constructive feedback when they received it. For example, L20 found it 'Particularly useful', in the Enzymes in Biotechnology & Disease unit, to be told of some things that were good and some that could be improved about a presentation - for the benefit of the presenting student, not for assessment. This final year student had also noticed that 'They have made more of an effort providing feedback which has helped me a lot in my learning. If only they had done this from the beginning!'

Students wanted 'Just a couple of sentences from the examiner to explain what was good and bad [to help us] do better at exams in future' (L9) and 'Feedback from all my exams since the first year' (L4). Receiving feedback

‘One-to-one with your tutor would be best’ (L11); other departments apparently had such a system but Biology & Biochemistry did not.

Findings on programme-wide influences on learning

There is, of course, a link between workload, assessment and feedback. It seems that the Department set a high number of assessment tasks which contributed to a high workload for students (snowed under, overwhelming), particularly in their second and final years; often, completion of assessment tasks became the Object of their activity, rather than reading or studying which were squeezed out. At the same time, high levels of assessment give staff a heavy workload in terms of marking and they may not have time to provide informative feedback. Sadly, this deprived students of a useful form of Mediation, one which might have facilitated their learning and lead to improvements in their standard of work. Student stress (panic, anxiety), induced by heavy workloads and negative feedback, had a detrimental effect on their confidence, self-esteem and mental attitudes and this inhibited their learning (‘They conspire to stop you reading’, ‘Pushes some of my studies away’). Barnett (2005) referred to ‘The Fragility of Being a Student’ with regard to student confidence and the will to learn; ‘fragility’ is a good word as it is a reminder of the need to care for students and nurture their learning. Staff, too, suffer stress from their assessment load and other pressures; they have their own fragility and need support.

As with placements and practical classes, students sought to avoid or minimise their stress, e.g. by not doing extra reading which ‘If I tried to do it, I would stress myself out’. Sadly, it seems that a stressful period as an undergraduate may discourage some MCB graduates from taking advantage of lifelong learning opportunities. For example, while on placement L19 was ‘Sure that I want to go to grad[uate] school and do a PhD’ but, despite gaining a first class MBiol, gave up the idea in response to a final year which she found stressful and L22, who graduated with a first class BSc but disliked the idea of becoming a postgraduate student, said ‘I never, ever, ever, ever want to do any single exam ever again in my life, I know that. The further it

went on, the worse and worse I got. I'd be a nervous wreck by the end [of a PhD]'. This is at odds with the University's espoused theory of encouraging lifelong learning.

Learning outcomes from degree programmes

Students do learn; of course they do. It is an innate ability of human beings to learn from their experiences. Whether students learn as much as they could do, or as easily, is a moot point but the evidence suggests that undergraduate learning on these degree programmes was not always actively promoted and that some students, at least, found their learning hindered by the circumstances surrounding their learning opportunities on placement and/or at university.

Learning outcomes from doing a degree, and especially from undergraduates' experiences more widely, are highly problematic. On one level they are the degree classification itself (First, upper second and so on) but, on another, they are impossible to classify and impossible to attribute causally to university-provided learning opportunities. I shall give just a few varied examples:

- 'Practical skills, approaches to experiments, calculation ability and problem solving all improved 100%. Learnt how to communicate scientifically … Without it – I'm not sure how good a scientist I'd be.' (G9 referring to her placement.)
- 'Allowed me to build a much broader scientific knowledge base' (G5 on his placement).
- 'Helped me grow as a person, especially being out of the country … I grew ten years in experience and maturity … certainly a change to escape my old influences and really discover myself … facilitated by several people I met … with more life experience, who are more cultured, more intelligent and quite inspiring.' (IR17 referring to informal learning from the social aspects surrounding his placement.)

- L23 remarked that university life (without a placement) was 'About learning life skills as well. Having been to university, I've changed so much. Even if I don't come out with a good class degree, I've learnt a lot and got well equipped for life.'

Final research question answered?

The final research question was 'How does placement learning compare with that from university-based learning opportunities?' In a sense, the answer was present from the start when a biochemistry student wrote that she had learnt more in 2 weeks on placement than in her previous two years at university. When a placement is good, its Object of activity is successful completion of a research project or other meaningful work, there is ample Mediation and the Learning outcome is often deep understanding; this type of placement has far higher learning potential than can be afforded at university where the Object of activity is usually meeting assessment criteria to obtain a good degree, where the ratio of students to staff is high, the number of staff-student interactions few and the learning outcome debatable.

On the other hand, high numbers of undergraduates do learn a considerable amount at university and in some depth; they learn about their subject but also become better 'Equipped for life'. Data given here does, however, suggest that there may be some shortcomings in teaching quality and hence that university learning could be better facilitated than it is at present. Areas for possible improvement are considered in the following chapter.

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On the following pages I consider another matter which impacts on undergraduate learning, but on a wider than programme level; that of the institutional culture of the Biology & Biochemistry Department and the University of Bath. This thesis has focussed on undergraduate learning at programme level and its analysis was at the micro level. It would, however, be wrong to ignore analysis at meso and macro levels since the work of the

Department and University as a whole impact on undergraduate learning and so does the wider culture of HE in England in the 21st century.

Analysis of institutional culture within the University of Bath, from the perspective of some of its undergraduates

Institutional culture inevitably influences learning. It is the medium in which undergraduates exist and which, if it contains appropriate constituents, may provide them with a nurturing environment within which to grow, develop and fulfil their personal potential. Culture influences both activity and mediation and impacts on students' perceptions. I therefore need to look further at the University's ethos.

Which theories does the University of Bath espouse for its undergraduates? The first paragraph under 'Studying at Bath' in the University's Undergraduate Prospectus 2004 was as follows: 'Breadth of knowledge, quality and flexibility are the hallmarks of a University of Bath degree. Our programmes provide our graduates with the skills necessary to meet the demands of a changing and a challenging global environment. Our students are targeted by most major employing organisations' (p 12). The first sentence espoused knowledge and quality but the second and third sentences suggest that the purpose of a Bath degree is the acquisition of skills for employment.

The emphasis in the Undergraduate Prospectus is, of course, teaching and learning but the University's Learning and Teaching Strategy (7/4/2005) describes what the University espouses: It 'Aspires to be a world class, research University offering high quality teaching in a high-technology learning environment' (p 1). The University sees the relationship between research and teaching as 'Complementary activities and believes high quality teaching of the type it aspires to can only be achieved in combination with the invigorating stimulus of active research. In support of this, the University aims to provide opportunities for students to learn in a research-intensive environment, taught by staff working at the forefront of their subjects' (p 2).

Activity, Mediation and Students' Perceptions

One participant's data seemed to question the idea that research and teaching were complementary in practice: L25 felt that the research-based nature of the University was 'Very much to [students'] detriment', that lecturers were 'Primarily research people, being made to lecture us on top of what they do' and that this explained 'The very low lecturing ability of many of the lecturers'. He had come to feel that Bath students were 'Lowly undergraduates - we're a burden that they have to lecture to … not important'.

Some students felt the impact of increased student numbers: 'There are too many people here', the University is 'Entirely financially motivated' (L24, L25) and there is 'Pressure for very limited resources' (L4). This student said that other universities she had visited 'Have managed to increase their resources to keep up, but Bath hasn't'.

The anticipated introduction of top up fees was reflected in two statements: 'If I was paying £3,000 to come to university I'd expect the person lecturing me to know how to teach. I don't think that's too much to ask' and 'You expect quality when you pay for something' (L22, L23).

At a departmental level, some students thought that 'The researchers (lecturers) generally make enough time to teach as well as doing research [and] values its students' (L3). Others felt there was little support and encouragement and one respondent thought the Department 'Elitist' and that it 'Should be doing all it can to help average students and students like myself [with health problems] to achieve to their best ability … I feel they're not. I'm just not that good. Maybe had the Department been more friendly and supporting I wouldn't feel like this' (L2). It seems that the culture is not encouraging each student to fulfil their potential.

What effect might these perceptions have on learning outcomes? While poor teaching quality does impact on learning, it is difficult to judge what effect feeling 'Lowly' or 'A burden' has on student morale but, if Barnett is right (and I believe he is) about student 'fragility' (Barnett 2005), such feelings could have negative impacts on learning.

Lastly, I want to consider whether the University is aware or unaware of its students' perceptions of their learning and teaching environment. Students criticised the methods used for collecting and evaluating their feedback: 'They only had boxes so you couldn't really write much. You had to write it on the back, and they only gave the sheets right at the end … and that wasn't a good time because everybody rushed them because they wanted to go' (L3), 'Feedback cards are just no good at collecting meaningful feedback as people rush and don't take them seriously' and 'Nothing happens' as a result (L12, L17, L18, L19). In Staff Student Liaison Committee (SSLC) meetings: 'Lots is said and nothing is listened to. Because [student representatives] made a complaint about a lecturer and they were told "You can't just complain about someone because you don't like them". We're not complaining because we don't like her, she's just not very good, and it was not taken on board at all. You don't criticise and that's it' (L22). Also, an overall response rate of only 11.5% in the recent Student Satisfaction Survey begs the question 'Just how representative are its conclusions'?

Findings on the culture at the University of Bath

The University proudly declares its research focus in much of its publicity material and may be unaware that some of its students consider this to be detrimental to them as undergraduates. The realities of HE in the present political climate (see, for example, Evans and Abbott 1998 and Ramsden 1992) are that research does indeed take priority over teaching and that universities do have to be financially motivated. However, commodification turns undergraduates into customers and there is a need to keep HE customers satisfied. It seems, though, that some of the University's students appear to feel that their voice is ignored; some of them (both top and

'average' students) felt undervalued and powerless to influence the quality of their undergraduate experiences at a time of increasing pressure on resources. It will be interesting to see whether the imminent introduction of top up fees empowers students and gives them a voice and whether it does or does not lead to improved teaching quality.

That would be a rather downbeat paragraph with which to end this section so let us not forget that, in the words of a 1998 graduate, students' experiences could also be 'Incredibly positive, best years of my life' (G6).

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Below I analyse learning to teach at the University of Bath, from the perspectives of some academic staff, using the same framework which was used to analyse students' learning opportunities.

Analysis of learning to teach at the University of Bath, from the perspectives of some academic staff

The University of Bath's Teaching Development Programme (2005c) aims to provide staff with 'The skills and knowledge to become effective teachers in the context of a research-led university' and to encourage new staff 'To question and evaluate their practice in order to improve the quality of the student learning experience'. It espouses effective teaching (although it is research which leads the university) and improving the quality of "The student learning experience", which almost suggests the University believes that all students have the same experience!

Object of activity

The intended Object of activity is, of course, learning and professional development of teaching staff, and gaining knowledge through background reading. The Objects actually reported by participant academics who experienced this programme involved wading through 'A pile of

documentation weighing >5kg that was ~8" thick' and jumping through hoops or getting ticks in boxes, presumably to satisfy assessment criteria. 'In reality, you don't' have time for recommended reading.

Mediation

Staff Development personnel were described as 'Chaotic' and the handbook and portfolio as 'A nightmare'. The reading 'Might be OK if you had time to do it'.

Learner Individuality

There were insufficient data on this.

Learning outcomes

One lecturer wrote that he 'Gained about 10% benefit from what was taught' and the professor wrote of another lecturer who 'Was poor to begin with and, from all reports, hasn't improved', describing the programme as 'Patently and manifestly a total waste' of time.

Findings on learning to teach

I must point out that my sample size was only three and that these perceptions may not be representative. However, it is interesting that academics-as-learners may have had many of the same issues as did their students. Lecturers too may have had different Objects of activity from those espoused (by Staff Development at the University of Bath, its Learning and Teaching Strategy or the ILT/Higher Education Academy) and the support for academics-as-learners, and the messages they experienced, may not have fostered their learning or their development into better teachers.

There were fascinating parallels between the perspectives of undergraduates and academics on their different learning opportunities and both groups used

somewhat extreme language to describe what they saw as shortcomings; I do not know whether the professor's views were representative or exceptional when he wrote that the process involved in learning to teach was 'Patently and manifestly … a total waste of [the lecturer's] time and mine - in fact everyone's except those whose careers depend on staff development initiatives'.

The analytical framework used in this research, which was originally derived from learning opportunities on placement, seems to have been informative about university-based undergraduate learning opportunities too. In addition, it seems that it might prove to be a useful tool for understanding lecturers' perspectives on the opportunities available to them while learning to teach.

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The following pages are a summary of the research findings.

Summary of Research Findings

This research aimed to understand undergraduate learning at programme level from students' perspectives. Initial research attempted to answer the following questions:

- **What is the nature of placement learning?**
- **How does placement learning come about? What promotes and inhibits it?**

Early in the research process, it became apparent that placement learning could sometimes be 'special' but that the nature of placement learning was very variable. Placement learning could involve nothing more that the acquisition of skills or it could be transformational, leaving the student altered in ways which they and others could recognise; often this involved the student in becoming noticeably more mature as a person and in their relationship with the world. Sometimes the theory espoused for placement learning (and that commonly seen in the literature) involves only vocational work experience or the acquisition of skills, and placements may be seen as an administrative problem (of providing enough placements to meet student demand) rather than a matter of academic quality. I have argued that the best placements can lead to learning far beyond this and that recognition and espousal of a broader theory might lead to improved placement opportunities for more students.

Placement learning appears to come about through doing placement work in the host institution alongside, and interacting with, colleagues and peers. This accords with modern Socio-cultural and Activity Theories (see Vygotsky 1978; Engeström, Miettinen and Punamäki 1999; Daniels 2001) which recognise that learning occurs through activity in a cultural setting, mediated by the tools, language, ways of thinking and behaving of the social group or community in which the learning takes place. Learning is promoted by engagement in activity

which has meaning for the learner (which becomes their focus of attention, purpose, goal, the Object of their activity) and when the learner is challenged to achieve at slightly higher than their current level of knowledge and understanding, where their learning is supported appropriately and where they feel comfortable emotionally. Learning is hindered if the learner does not engage with the activity, if it holds no interest, meaning or relevance for him/her, when it fails to challenge, where the learning is not supported or where the learner feels uncomfortable in some way (e.g. unhappy or anxious). The attributes of the individual student also influence their learning outcomes.

Placement situations are very different from university-based learning situations, particularly with regard to the opportunities available for engagement in meaningful activities and the level of support available to individual students. Good placements provided students with research projects or worthwhile work that, with the help and encouragement of supportive supervisors and nurturing environments, they could make their own; students became able and confident experts in the area of their placement work. When placements were like this, when their learning potential was high, then placement learning outstripped anything that could be achieved at university and students reported learning 'More in two weeks on placement than in the previous two years!' and 'The placement was undoubtedly the best aspect of the whole degree – absolutely invaluable. STUPENDOUS!'

The knowledge gained into placement learning, and the model and analytical framework derived from it, contributed to an analysis of university-based learning opportunities which attempted to answer the question:

- **How does placement learning compare with learning from other aspects of the Molecular and Cellular Biology programmes?**

However, a second strand of analysis was required to explain the disparities which sometime occurred between anticipated and actual learning outcomes. This second strand was provided by consideration of Theories of Action (Argyris and Schön 1978). Findings on university-based learning and matters which impacted on it were as follows:

University-based practical work was sometimes seen as relevant; then students engaged with it and, with support, worked towards understanding. Often, though, they saw practical work as irrelevant and 'A waste of time'. They felt unsupported ('In a muddle all the way through') and over-stressed; under these conditions they reported learning little.

Some lectures facilitated learning but some were seen as very poor. Preferred lectures involved traditional 'chalk and talk' where the lecturer had enthusiasm for the subject and talked directly to students at a pace that enabled them to write brief notes and to listen and think. It seems that the closer lectures approximated to natural human dialogue between lecturer and students, the better students thought them. The most criticised lectures were those with huge class sizes and those in which a large amount of material was covered by the lecturer, often using PowerPoint and reading from slides.

Tutorials were successful where the tutor was seen as caring and had some personal interaction with students. Often they fell short of this ideal.

While at university, and particularly during their final year, students frequently mentioned their high workload ('snowed under', 'overwhelming'); often, completion of assessment tasks became the Object of their activity, rather than reading or studying which were squeezed out. In addition, they reported receiving inadequate positive or only negative, feedback which contributed to their stress ('panic', 'anxiety'). This combination of circumstances had a detrimental effect

on their confidence, self-esteem and mental attitudes and inhibited their learning ('They conspire to stop you reading', 'Pushes some of my studies away').

It seems that university-based learning situations often fell short of what was espoused for them in terms of the Objects of students' activity, their learning support and the messages which students experienced. Further, what the University of Bath and its Department of Biology & Biochemistry have espoused as their theory of Higher Education seems to be the skills-for-future-employment definition, in vogue under New Labour. I am one of many people who feel that Higher Education should espouse higher aims than skills-acquisition for the sake of our society (which is more than ever in need of such human virtues as wisdom and tolerance) but at least it would be good to ensure that degree programmes met the lesser aims which are currently espoused for them.

The Department of Biology & Biochemistry is a first rate teaching department and its 2006 undergraduate prospectus refers to the top marks of 24 out of 24 achieved in its QAA Teaching Quality Assessment, in 1999. It is interesting that my research into students' perceptions of their learning situations suggest that there might, nonetheless, be considerable room for improvement.

The research also revealed interesting parallels between students' perspectives on their undergraduate learning opportunities and the perceptions of some academic staff of the learning opportunities they were offered while learning to teach at the University. There might, the data suggests, have been considerable room for improvement in this area too.

The findings described so far relate to the specifics of learning and teaching at programme level but the most significant finding was methodological. The major finding, I believe, is that students'

perspectives of their undergraduate experiences, gathered through open dialogue with them and analysed using Socio-cultural and Activity Theory and Theories of Action, seem to reveal valuable insights into the actuality of undergraduate learning opportunities.

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This chapter has analysed the different learning opportunities afforded to students following Molecular and Cellular Biology degree programmes at the University of Bath and concluded with a summary of the research findings based on students' perspectives. Of course, students' perceptions reveal only one reality and staff or other stakeholders have different perspectives. Nonetheless, might these findings point to areas where the gap between espoused theories and theories-in-use could be narrowed? Might this knowledge help to improve the quality of learners' experiences? I believe so.

The final chapter discusses the significance of these findings and makes some recommendations which may have wider implications beyond MCB and beyond the University of Bath. It also considers the contribution to knowledge made by this research project and thesis.

CHAPTER 8: DISCUSSION AND RECOMMENDATIONS

The previous chapter described the research findings but so what? What is the significance of this research? In this final chapter I consider the significance of this project. Then I consider the limitations of the research and how these might be addressed in future work. Finally, I anticipate a sceptical reception for this research and consider what might be its unique contribution to the existing body of knowledge on undergraduate learning.

In Chapters 4 and 6 I pieced together a narrative of what first-rate teaching (QAA 24/24) felt like from students' perspectives. In some respects I found it a disturbing story; for example, when I began this research I believed (from my own experience of one good and one excellent placement, and from my time as Placements Tutor) that almost all of the Department's placements provided excellent opportunities for learning. Yet enquiring closely into the experience of other students suggested that perhaps 36% of our placements were poor in terms of their learning potential.

Since I was better placed than most to know about our placements, why were my beliefs then so far from what I now believe to be the 'real' situation? I think that theories espoused within the Department may have got in the way of my understanding, that a limited amount of interaction with students during their placements may have compounded the error and that, with the expectation that our placements were good, staff inclined to the view that any shortfall in learning could be blamed on problematic students.

While the data may tell a disturbing story about placements and about university-based teaching quality, the understanding to be gained from students' experiences is very valuable and, once analysis has suggested where and why there are programme weaknesses, then the opportunity exists to improve the situation. Appendix 4 contains the recommendations on Molecular and Cellular Biology programmes at the University of Bath which I provided to the Chair of the MCB Teaching Committee in July 2005.

It just so happened that my study of undergraduate learning was carried out on MCB students at Bath, rather than students from another programme or institution. Were these undergraduates' experiences unique or might students elsewhere have had similar concerns? It is my contention that higher education institutions cannot be sure of the quality of the learning opportunities they provide, unless they are asking appropriate questions of their students (end-users, consumers). They may be garnering student opinions, through surveys, yet failing to discover what their students think and feel and, in particular, why. It is possible, even likely, that many of the findings from this research could have implications elsewhere in the HE sector and the recommendations given in the following sections are those which might have generic significance. Before outlining these, however, there is one important caveat: learning is a complex and multi-factorial business and interventions sometimes have the opposite effects from those intended (e.g. Marton and Säljö 1984; Ramsden, Beswick and Bowden 1986). Further research would be necessary to evaluate the effects of implementing any of these recommendations.

Evidence-based recommendations

In each case, I shall give a brief reminder of the research findings followed by bulleted recommendations.

General

1. Transition to University

First year students took a long time to settle in to appropriate study and revision methods: '6-7 months', 'A year to get back into it'. Second year revision, but *not* first year, involved 'Actively get[ting] it into your brain instead of just sitting there reading it from a book'. It seems that, although successful enough at learning to achieve high grades at A-level, new entrants may find the transition from school to university difficult. Why should this be so? Sinclair (2005) states that 'Students frequently report that university is

nothing like college and for some the transition is an alienating experience … "Sometimes it's like being on another planet." I have frequently heard students observe that they do not know what lecturers are talking about, that they are aware of having been "spoonfed" at college, and that they just do not know what is expected of them, yet feel that they somehow "ought" to know' (pp 2-3).

- Compulsory study skills (if well taught) might help some students to understand the point of lectures and what was expected of them and to develop techniques necessary for success at university.

2. Teaching quality

There may be huge disparity between theories espoused for teaching quality in published material and the theories-in-use experienced by students: 'First-rate teaching' and 24/24 in a TQA versus 'Very low lecturing ability of many of the lecturers … very much to our detriment'.

- Departments may want to enter into dialogue with their students' on their perspectives of the quality of their teaching and learning opportunities.

3. Subject relevance

Some subjects may be considered, by students, to be a waste of time. Should we attribute this to student ignorance or give their points of view some credence? When a professor writes that an activity is 'Patently and manifestly a total waste of time', we are inclined to believe that his or her opinion is based on wisdom and experience; it is my case that students' opinions also have validity. As mentioned earlier, 'University students are extremely astute commentators on teaching. They have seen a great deal of it by the time they enter higher education. And, as non-experts in the subject they are being taught, they are uniquely qualified to judge whether the instruction they are receiving is useful for learning it. Moreover, they understand and can articulate clearly what is and what is not useful for

helping them to learn' (Ramsden 1992, p 89). From a constructivist standpoint, only undergraduates themselves can say whether or not a given learning opportunity has value for them.

- Departments and universities might like to enter into dialogue with their students about what is and what is not helpful and supportive of their learning.

4. Workload, Assessment and Feedback

Research findings suggest that a high workload may get in the way of students' reading and studying: 'They conspire to stop you reading up on lectures; there's so much else to do', 'It's stress [when] the priority is either finish your coursework before the deadline or do some background reading. You'll always do the coursework' and, referring to project work, 'Takes up a lot of time so pushes some of my studies away'. It seems that the Object of students' activity had become completion of set tasks, rather than reading and studying. Perhaps a more manageable workload would allow students time for reflection and for repetition, as well as for reading and studying. Further, overloaded students reported high levels of stress, 'Panic' and 'Anxiety'. Under these circumstances, they gave up reading recommended reference material 'Simply because I don't have time to do it. If I tried to do it, I would stress myself out'. High workload and a large amount of assessed coursework forced students to adopt surface or strategic approaches to their studying (Marton and Säljö 1976; Entwistle and Ramsden 1983). Louise Grisoni's work links high anxiety with reduced independence in what she calls the Boomerang Effect; it suggests that, if one of the aims of degree programmes is student autonomy, then students should not be over stressed (Grisoni 2004).

There is general agreement, across the sector, that over-assessment needs to be addressed. Often, though, this refers to staff workload, rather than the workload experienced by students (Rust 2005). My data suggest that fewer assessments for students would be likely to have a beneficial effect on their

stress levels and that this might have a beneficial effect on learning. Fewer assessments could be achieved if the compulsion to take subjects seen as irrelevant was dropped (as recommended above) and students were allowed to attend fewer lecture and practical courses.

Exam stress could perhaps be reduced by first year study skills classes and by telling students what to expect from exams in their first year or when unfamiliar formats are introduced ('No idea of what was expected of us. There are past exam papers but no model answers'). Exams where students have plenty of time are likely to be less stressful than rushed ones and may help to address the belief that some exams were a test of writing speed. Assessment methods other than exams should perhaps be encouraged, e.g. practicals assessed by workbook and interview (while avoiding the serious pitfalls of some student seminars, mentioned above).

With fewer assessment tasks it should be easier to provide prompt and formative feedback, guiding students towards potential improvement. A change may be underway for final year students but is needed 'From the beginning!' in order to help students improve the standard of their work. As Tharp and Gallimore reported in 1988, 'Feeding back information on performance is a powerful means of assistance. On an experimental level, it often seems a sufficient means. Mere feedback frequently is enough to guide a student to substantial improvement in performance on the next try' (p 54).

What I have referred to above is, of course, workload, assessment and stress levels *as experienced by students.* In order for Departments to understand these matters from their students' perspectives, they would need to collect suitable data; they would need to enquire of students '*How are things for you this semester?, What do you think of your workload? and How do you feel about what you are doing this term?'*

- Departments may need to collect student-centred evidence so that their practice can be better informed.

- Departments might like to research the Objects of their students' activities. If students are focussed on meeting assessment criteria, at the expense of reading and studying, consideration might be given to lowering the workload.
- Departments might like to improve students' understanding of assessment criteria and processes. They could consider the provision of model answers.
- Prompt provision of formative feedback would be helpful to students on all programmes.

Placement-related recommendations

Undergraduates felt ill-prepared for their placement work and some felt 'Completely useless' initially. A number of placements had little potential for learning, with work which was 'mundane', a lack of supervision and working cultures which were unsupportive. Often the Department did not know what its students were doing or how they were coping while on placement. Some students had serious difficulties. Learning outcomes varied widely; in some cases students reported learning very little, in others their learning was transformational.

- First and second year practical classes could be designed with the aim of preparing students for future practical work on placement (and elsewhere).
- The nature and quality of placements could be monitored more closely with regard to their learning potential, in terms of work/activity, supervision and institutional culture.
- Placements where the learning potential was low might gradually be dropped in favour of those with higher learning potential; this is a question of academic standards and it might be helpful for academic staff to oversee placement quality which, in this case, constitutes 25% of undergraduate experience for sandwich students.

- Placement quality might be enhanced if Placement Tutors and Departments espoused higher aims for their placements than merely the acquisition of vocational skills.
- Departments might like to initiate contact with their students, proactively, while on placement to check on their well-being. This would ensure that universities were fulfilling their duty of care in all cases and help to ensure that students considered paying half fees for placement year was good value for money.

Recommendations on practical classes

Students found practical classes very stressful, particularly when class sizes were high ('Bit of a shock', 'Panic') and when they had little guidance ('In a muddle all the way through'). Often they failed to see the relevance of their practicals, both at the time and after several years of postgraduate study or employment 'Almost without exception, a complete waste of time … gave me absolutely no useful training for working in a lab'. 'Convenors should not cram too much into a lab session - we don't learn any more by having to rush through lots of exercises, we just get stressed and resent having to do them!' As a consequence, 'The general gist of practicals is that everyone hates them and does them as quickly as possible … no-one cares what they do' and students 'Formulated the results entirely from my imagination'.

The fact that two cohorts, quite some time apart, both reported learning little from practical courses suggests that the Department had been wasting its time and resources for a long while. If they had known this, they might have been able to remedy the situation. This suggests that their method of collecting student feedback (lottery style cards) was not particularly informative. Formative feedback to students on their practical work was often lacking 'We haven't really had much feedback at all'; laboratory written work was returned 'With no comments on at all, so I had no idea whether I was doing right or not'.

There were examples of good practice, where practical courses were designed and implemented with student understanding in mind and 'You really do understand it' or when the atmosphere was 'More laid back, take your time and do it as well as you can'; sadly there seems to have been little dissemination of good practice throughout the Department.

- Huge laboratory classes may not be a good idea. Class sizes could be reduced if each student did fewer classes than they currently do. 'Waste of time' courses could be dropped; the loss of some practical courses may not affect learning adversely, as they seem to have contributed little.
- In the remaining classes, students might benefit from more guidance on their practical work (through teaching, demonstration, well-written handbooks and the opportunity to read and understand them in advance of the class) and from the provision of formative feedback.

Providing fewer, but better quality, practical classes has the potential to enhance learning while economising on resources.

- The type of feedback collected from students could be altered in order to monitor student perceptions, their stress levels and their views on learning from practical classes. The Object of their activity in practicals is important; are they trying to learn or rushing to escape a situation they see as unpleasant?
- Student feedback could be used to establish which practical units cause student anxiety and what it is about those units that students find stressful; I believe that feedback cards would be inappropriate for this purpose.
- Departments might like to disseminate their examples of good practice in practical classes.

I must point out that the provision of high quality practical classes for undergraduates is a widespread problem. In *Teaching in Laboratories*, Boud, Dunn and Hegarty-Hazel (1986) wrote that physicists from Massachusetts

Institute of Technology were so dissatisfied with their undergraduate laboratory courses in the 1970s that they stopped teaching them for a year and devoted the time to devising new ones.

Recommendations on lectures

As with practical courses, some lecture courses were seen as irrelevant. For example, Organic Chemistry probably has more relevance to Biochemistry students and Biodiversity to students of Biology. When compulsory for MCB students, such subjects do not engage them or broaden their minds. Students do, however, have to learn enough material to pass their exams. It may be that this forces them into superficial or strategic approaches to their learning and perhaps gives rise to the resentment expressed by both 1997/8 graduates and participants in the longitudinal study 2001-2005; that both groups raised the matter suggests that teaching such subjects may have been ineffective for some considerable time. If the compulsion to learn fringe subjects was dropped, there would be a reduction in class sizes and in student workload: 'They conspire to stop you reading up on lectures; there's so much else to do' but 'You are happy to do lots of extra reading for your own enjoyment and interest … you'll do more for things that interest you'. It seems that a system involving large numbers of students attending large numbers of lectures may have more to do with teaching efficiency than with teaching effectiveness.

Chalk and talk lectures were praised. They were more successful at keeping students' attention than some PowerPoint lectures yet there was some pressure on academic staff to adopt PowerPoint and some lecture theatres are not equipped for chalk and talk lectures. Why would a Director of Teaching recommend PowerPoint when all the evidence from students (whether gathered by one of their professors or by me) was in favour of traditional lecturing? Perhaps the Director of Teaching had contradictory evidence or perhaps there was pressure on him? I do not know. I would advocate student-evidence-based practice in this matter because only

students can say the effect which different teaching methods have on their learning.

Innovative teaching methods may be an efficient means of disseminating information or 'facts' but are they effective at facilitating student learning? While some innovative teaching methods may require further research before their widespread introduction can be justified, there would seem to be great potential in this area. PowerPoint, when used effectively, can be excellent but perhaps there is a need to define its effective use. Web pages can be a useful source of information when used effectively but again 'effective' needs to be defined. Webcam technology, suggested by one participant, might be an excellent way of getting good lectures into the homes of students and could benefit some groups particularly (mature students with long commuting distances, students with illnesses like ME or glandular fever, hard of hearing students, dyslexics, those who missed the lecture because of project work, interviews, etc). Note, though, that this use of technology would not do away with the need for good quality teaching, it would merely deliver it in another way. Those who wanted to attend lectures could do so but those who would rather not could view the lecture (repeatedly if desired) and make their notes at home. This would also reduce the pressure on resources.

For all the talk of innovative teaching and e-learning, much university teaching, particularly in the first two years, is based still on traditional lectures. Is there anything that can be done to improve this area? The data suggest that what students identify as 'good teaching' approximates to normal human interactions and that the further the lecture situation departs from natural dialogue the more likely it is to be seen as poor. Small classes may be better than large ones. In large classes 'You don't stick your hand up and ask', while in small ones students felt 'Less isolated', the atmosphere is 'More friendly', 'If somebody's actually speaking to you rather than reading … it's their own words. You can concentrate more', if the lecturer is 'Enthusiastic' and 'Seems to care and know who you are' then students seemed to feel that the lecturer was addressing them personally and that they should engage in what was being said. It follows that people with poorly

developed interpersonal skills may not naturally be good lecturers but perhaps observation of those with an instinct for empathising with students, and a talent for engaging them, would help.

Perhaps the greatest asset for a lecturer would be to see the subject from the student's point of view and to teach to their level of understanding, aiming always for clarity and eliminating ambiguity and confusion wherever possible. In terms of the skills associated with good teaching, students mentioned several matters: Lectures should be about the 'Whole picture', the 'Global view', about 'Giving you a framework' and broad principles, rather than 'Everything there was to know' on a subject. Tharp and Gallimore wrote, in 1988, that lectures were good for 'cognitive structuring … the wise teacher can economically and efficiently provide structures of understanding' (1988 p 63) or schema. Pace was important in lectures; it should be slow enough to allow students to take notes (but not so many notes that this becomes the main Object of their activity) and slow enough to allow them to think about the subject matter (but not so slow that they become bored); of course, the answers students give when asked about pace depends on their Object, whether understanding and jotting brief notes or trying to capture the lecturer's every word. Students benefited from being given outline notes in handouts, not detailed ones which discouraged their own input (they tended to memorise such notes and regurgitate them without personal meaning). Diagrams should be as simple as possible and more complex ones 'constructed' in front of the class, by hand or perhaps using PowerPoint animation. There are many good books which deal with university teaching in more detail, including *Learning to Teach in Higher Education* (Ramsden 1992). Learning to teach at the University of Bath was the subject of a small amount of data collection from academic staff (Chapter 6 and forward).

I would question the usefulness of peer observation as a means of judging lecturing ability as it is the students' views of lectures which influence their learning and this cannot always be determined by another lecturer.

- Subjects that students saw as a 'Waste of time' could perhaps be made optional, rather than compulsory.
- Situations where the lecture approximates to natural human dialogue could be encouraged where feasible. This might include smaller class sizes, reduction in technology, use of lecturers' first names etc.
- Traditional 'chalk and talk' teaching could be encouraged and teaching quality fostered. Of course, lecture theatres would need blackboards and lecturers would need supplies of chalk.
- Where individual lecturers have styles which students find unhelpful (information overload, unstructured and 'bitty' lectures), consideration might be given to identifying areas for improvement.
- The use of PowerPoint lectures might be monitored so that its mis-use could be minimised and good practice disseminated.
- If innovative teaching methods are to be introduced, then their use should be researched theoretically beforehand and monitored in practice after introduction to establish their efficacy.

Recommendations on the small group tutorial system

A few tutors were excellent, in terms of the level of care they provided and the nature of tutorial work set; students benefited from relationships with these tutors. Others were less good or just too busy to support their tutees' learning to any worthwhile degree. Such tutors are unlikely to respond well to prescriptive interventions. Is there, perhaps, a better way of fulfilling the Department's duty of care and encouraging small group learning? Perhaps the present system, whereby many members of staff each have a few MCB tutees, could be replaced by one with a single member of staff acting as tutor for all students studying the subject. An MCB tutor need not necessarily be an academic (although they would need to be a graduate with a related degree); such an arrangement might be effective just so long as that member of staff was someone who cared about and empathised with students and could dedicate time to them.

Providing students with someone to whom they could 'Let off a little steam!', someone who could act as a 'Whinging outlet', might help them to deal with negative emotions; it might help to 'Ease the passage' through stressful times. Importantly, such a person might also help the Department towards a better understanding of students' concerns, collectively and individually.

Work could be set with the specific intention of helping students towards skills such as sourcing information, writing essays, giving presentations, data analysis, experimental design and critical reading of primary papers. Feedback on this work should be constructive and encouraging of further effort, rather than negative and destructive of self esteem. Group work in a safe and friendly environment, guided by a member of staff whose brief was tutorial-type support, might help students towards a sense of identity and provide an opportunity for peer support which may be lacking.

- Departments might like to address the issue of variation between tutors, and the amount and nature of tutorial work they set, which could otherwise result in some students being disadvantaged compared with others.
- Departments might like to stipulate the skills which students are expected to practice through tutorials and the amount, nature and timing of feedback provision.
- Allowing students some choice in the subject matter of their tutorial work is likely to engage them more than work which is of no interest to them.
- Departments might like to consider alternative methods of providing tutorial-type support for undergraduates.

<u>Recommendations on seminar presentations</u>

The research findings presented here strongly suggest that the system of final year student seminars sometimes had detrimental effects on student confidence. Some seminars were 'Scary', judgemental and resulted in students feeling 'Torn apart' and 'Very low'. In *Moving towards autonomy in learning*, Boud states that what is important in helping students to achieve

autonomy ‘Is the attitude of teachers towards their students … an attitude of acceptance and appreciation of the views, desires and frames of reference of learners. Perhaps the single central quality which fosters autonomy is the quality of the relationship between teachers and learners which develops through this acceptance’ (1981, p 39). Such a conducive atmosphere was achieved in the Enzymes in Biotechnology and Disease unit but not others and good practice seems not to have been disseminated.

The ways in which students referred to seminars and their assessment, involving aspects of peer assessment and/or assessment of students’ contribution to class discussions, left me confused about the objectives of seminars.

- Departments could consider giving their undergraduates presentation skills classes and experience of presenting earlier in their programmes than the final year, when students are required to present on technical subjects at degree level.
- The destructive effects of judgemental cultures in some seminars could be counteracted by dissemination of good practice, where the provision of a supportive atmosphere and constructive feedback helped students to gain confidence at presenting and to improve their technique.
- Students (and perhaps staff) might benefit from a clearer definition of the aims of student seminars. Is the primary aim to gain subject knowledge or is it to gain presentation experience? Are students expected to learn from each others seminars and, if so, are they intended to learn about the subject matter or about presentation skills?

Seminar units could be better conceived and designed from aims and objectives to assessment and feedback to achieve ‘constructive alignment’ (Biggs 1996) or ‘congruence’ (Hounsell 2005).

<u>Recommendations on final year projects</u>

When it came to final year projects, non-placement students were disadvantaged, compared to their post-placement peers, because university

practical classes 'Do not prepare you for "real" lab work'. As a consequence, non-placement students felt 'Chucked in there' and found the experience 'Nerve-racking'. Perhaps this should be recognised and non-placement students given more support than was sometimes the case and projects involving a limited number of new techniques. Otherwise the answer to '*Did you learn a lot*' from projects? may continue to be 'No' or 'It hasn't' really stuck … so rushed'.

Post-placement students sometimes had considerable laboratory experience, often including independent research. They were generally comfortable with their projects and, being less needy, with the level of supervision. One felt she gained little from her project 'Considering on placement we're working for a whole year compared to 10 weeks on the project' but two Masters students, said they benefited from their more challenging projects through doing more independently than they had on placement.

- Practical classes could be designed to give students better preparation for placements and projects.
- Where placements are optional, departments might like to provide additional support for non-placement students at the start of their projects.
- Projects should involve a limited number of laboratory techniques if students are to master them and develop the ability to work independently.

<u>Learning and Teaching</u>

My glimpse into academic staff perceptions of learning to teach at the University of Bath suggested that this too would be a fruitful area for research. Academics-as-learners' perceptions of overload from the amount of documentation involved, coupled with the lack of time available for reading and learning, and their feeling that the system then in use was 'Patently and manifestly a total waste of time' suggests that there could have been savings here if less was done but done more effectively.

There have been changes recently with the establishment of the Higher Education Academy. Certainly I found the individual entry route to membership of the Academy straightforward in 2005; the time it took was consistent with the need for rigour without being unnecessarily onerous.

Institutional ethos

The participant who felt that students at the University of Bath were 'Lowly undergraduates - we're a burden that they have to lecture to … not important' was probably not in the right frame of mind to learn easily. In addition, and perhaps of some concern to the University, a student with this view of his Alma Mater, is unlikely to contribute generously to alumni funds in future. Universities may wish to ensure a good relationship between themselves and their undergraduates by making them feel valued, by valuing their views and acting upon them. Students' perspectives of departmental and institutional cultures and their impacts on learning would also be fruitful areas for future research.

* * * * * * * * * * *

Some of these recommendations may be relevant to universities in the UK and abroad, particularly with regard to placement learning, university teaching quality, student workload and assessment level, student stress and the provision of feedback.

However, my main concern is that universities cannot enhance teaching quality unless they have a thorough understanding of their students' perceptions. Many universities (not just Bath) have placed great reliance on student surveys even though there are snags: the response rate may be very low (e.g. University of Bath Student Satisfaction Survey 2003 had a response rate of 11.5%), the costs may be high (especially when cash has to be offered as an incentive to encourage questionnaire completion) and the results yield little specific information on how teaching quality might be enhanced. This research, on the other hand, has provided evidence which

pointed to specific areas where quality enhancement might be possible at both programme and university level. It suggests that a similar methodological approach might be informative for other programmes and other institutions. I would like to encourage a move towards evidence-based practice and have suggested both the type of evidence (students' perspectives) and its analysis (based on Socio-cultural and Activity Theories plus consideration of Theories of Action) which I believe to be considerably more informative than surveys at identifying areas where quality issues might be addressed.

There are dangers if universities see published data, e.g. the websites of partner institutions, as evidence of good practice. The role of Learning and Teaching Development Officer at Bath is largely concerned with just such published material, yet such research is, in my view, seriously flawed because it is based on espoused theories alone and takes no account of theories-in-use. To use the analogy of the Emperor's New Clothes (Hans Christian Andersen): espoused theories are likely to suggest that the emperor's suit is cut from cloth of gold while theories-in-use (the actuality of students' experiences) may reveal him in his underpants. My work has, I hope, demonstrated that research into learning is richer when it includes empirical data derived at local level, in context, through dialogue with learners (the recipients of learning opportunities), who are able to reveal theories-in-use.

I am not necessarily advocating long-term research projects like this one. However, I do want to suggest that the *approach* described here could be adapted for use elsewhere. This type of analytical approach to students' experiences might provide higher education institutions with a powerful tool for improving the quality of their learning and teaching at programme level and beyond.

The ethos of 21st century Higher Education in England

There are a number of factors which influence the current ethos of English higher education and I shall discuss just a few which have emerged from this research.

The Primacy of Research over Teaching

Some students have felt the impact of the currently espoused theory that research is more important to universities than teaching its undergraduates, believing it had a detrimental effect on teaching quality. I am not aware of any evidence suggesting that good researchers are necessarily good lecturers and some in HE (e.g. Pocklington and Tupper 2002) have argued that students may be short-changed by systems which privilege research and see teaching as a 'load' from which researchers can buy 'relief' or 'remission'. The students in this study did acknowledge that it was 'Helpful' being in a research environment but said it was 'Not helpful' when being taught by reluctant researchers who are required to 'Lecture on something they really don't have an understanding of'.

The establishment of the Higher Education Academy in 2004, means that there are changes afoot towards a scholarship of university teaching. The hope is that the pursuit of scholarship will lead to an increased status for teaching, to university teachers who are more knowledgeable about teaching and learning, and to a means by which teaching quality can be assessed. Trigwell and Shale (2004) share these aims but state that a good conception of the scholarship of teaching must, first and foremost, serve to enhance students' experiences of university learning.

The Quality Assurance movement

The pursuit of excellence is laudable and the quality movement well-intentioned but it seems that, as with assessment of undergraduates, so with assessment of universities under a culture based on 'quality' (government

driven and embodied by ILT, QAA and others). In both cases assessments can be stressful and tend to lead to the adoption of strategic, even surface approaches to quality. There is a tendency for universities to breathe a collective sigh of relief just as long as they meet the required minimum standards and, as a consequence, they may gradually come to accept provision which is adequate, rather than superb, in all aspects of higher education. Once teaching quality has been assessed as first rate (24/24), there is the danger of complacency, the sense that teaching quality is just fine as it is.

It worries me that quality audits may give too much credence to theories which are espoused and not enough to theories-in-use as experienced by students and that, in any case, the theories espoused for Higher Education are often narrow and, like those for placement learning, encompass only the acquisition of skills and competences for employment, while ignoring higher order learning (which is personal, internal, constructed and concerned with moral maturity), partly because it can never be truly measured.

Top up fees

My data contained only brief mention of the proposed imminent introduction of top up fees, in which two students made a connection between top up fees and teaching quality: 'If I was paying £3,000 to come to university I'd expect the person lecturing me to know how to teach. I don't think that's too much to ask' and 'You expect quality when you pay for something'. It will be interesting to see whether top up fees do, in fact, drive up teaching quality in the longer term.

Limitations and future research

This research has, I believe, illustrated something of the reality of undergraduate learning from the perspective of one small group of students studying one subject in a single, highly-rated department in a single, pre-1992 university but, as considered above, it may have relevance in other HE

situations. It did not, however, consider the age, gender, ethnicity, social background, educational background, psychology, biography and so on of students who may have different views. It looked only at an English university and made no international comparisons. Neither did it examine e-learning or innovative teaching methods. All of these areas would be interesting to explore using the methodology developed in the present study.

Postgraduate students (whether taught or research students) would doubtless be as interesting to research as undergraduates. Are espoused theories and theories-in-use aligned in their experiences? Do they see what they are asked to do as relevant? Do they perceive the supervision they receive as truly appropriate and sufficient? Do they feel that their growth is supported by a nurturing environment? It would be interesting, too, to study the interface between undergraduates and postgraduates working as demonstrators and teaching assistants.

In addition, this research did not look at the perspectives of academic staff, except for a brief mention of departmental teaching staff. It would be fascinating to analyse the views of lecturers-as-learners using the framework employed for undergraduates. Which theories are espoused for their learning within the University's new Learning and Teaching Enhancement Office, the Higher Education Academy and beyond, and which theories do lecturers-as-learners experience in practice?

Future research could also examine the cultural ethos dictated by the University's senior management. Is the University '*Entirely* financially motivated' (emphasis added) as one participant felt? What are the messages which percolate from the top down, from senior management to Departmental management teams and from them to academic and support staff? How do these messages impact on staff and students?

This research involved SCAT analysis mostly at the micro level and considered mainly individual activity. Analyses at the meso- and macro levels, could examine the tensions, contradictions and constraints within and

between Activity Systems in placement institutions, universities and beyond over time; the concept of activity in Activity Systems encompasses collective endeavour. Such analyses could provide a fuller picture and place this research in context. For instance, QAA and HEFCE both impact on universities and both espouse 'quality':

- 'We safeguard and help to improve the academic standards and quality of Higher Education in the United Kingdom' (QAA 13/6/2005).
- HEFCE 'Promotes and funds high-quality, cost effective teaching and research' (HEFCE 13/6/2005).

Since this research project has suggested that the quality of higher education opportunities can sometimes be poor, in terms of learning potential, and that , for example, some laboratory classes may not be cost effective, future research might compare the theories espoused by these national bodies with theories-in-use as experienced by their end-users, university students and staff at all levels.

Beyond this level, there are matters of national policy and this has been criticised. For example, 'Policies on funding, research and widening participation in higher education … while laudable in themselves, interfere with the operation of policies on teaching and learning to their detriment … higher education policies are not 'joined up' in this broader sense' (Trowler, Fanghanel and Wareham 2005, p439). Beyond 'policy' there is the wider culture. Our culture affects us all in diffuse but pervasive ways and we, each of us, are likely to have some influence on the culture we live in. It is my hope that the ideology, the philosophy, of writers like Ron Barnett will help to influence our culture such that students and their perspectives are valued and that each is helped and encouraged to fulfil their own potential and to move towards moral maturity and 'critical being' (Barnett 1997). This would help us all towards a culture in which such human attributes as tolerance and wisdom were valued above skills and competences.

Another avenue of research, which this project did not employ, is direct observation of learning situations which would, I think, have been both interesting and informative. Any researcher with an understanding of Socio-cultural and Activity Theories might be able to draw useful conclusions from direct observation of learning situations. This could be particularly useful in areas known to be problematic (such as a lecturer whose teaching was known to be poor) or in successful areas where the reasons for success had not been identified. Direct observation could help in reducing bad practice and identifying good practice which could then be disseminated.

One final area of research which might be fruitful concerns the relationship between two separate but related disciplines. Neuroscience is the study of brain structure and functions, including memory and learning, while Education is the study of the human mind in teaching and learning. It would be interesting to see whether a closer relationship between the studies of brain and mind, might lead to better understanding of undergraduate learning. [Plans are in place for me to host an event next year, on behalf of the Society for Research into Higher Education, which will attempt to bridge the gap between neuroscience and education.]

Anticipating a sceptical reception

In Chapter 6 I referred to 'sceptics' (p 142). A few years ago I might have been sceptical to hear that a third of our placements were poor. Therefore, I anticipate that the view of MCB undergraduates' learning presented in this thesis will be met with scepticism by other University staff. Their beliefs may be at odds with my new understanding for a number of reasons:

- I have given credence to students' perceptions. This may not, however, be the case in departmental SSLC meetings where 'Lots is said and nothing is listened to. You don't criticise and that's it'.
- I gathered data through open dialogue with students and employed a qualitative analytical approach. By contrast the Department and the University rely on mostly quantitative data analysis of feedback cards and

student satisfaction surveys; resulting 'scores' tell something of what students perceive but nothing of why.

- My work recognises that some of what students said concerned their learning situations while some of their comments related to differing individual perceptions of those situations. Quantitative analysis cannot make such a distinction.
- Related to the point above, there has been a tendency for the opinions of some students to be dismissed as 'extreme views' (Director of Teaching, 29 March 2004). The data demonstrate that both consensus and deviant views can be informative.
- The University's Student Satisfaction Survey had a response rate of only 11.5%. The response rate for my main longitudinal study was >86%.
- My analysis recognised that there may be disparity between espoused theories, as published by the Department and the University, and their theories-in-use. University staff at all levels may be unaware of such disparity.
- I collected data on the impact of different learning environments on students' feelings and emotions. I believe this aspect of learning is largely neglected by academic departments.

It is inevitable that those whose approach to understanding students' experiences is based on pre-determined questions, whose analysis is quantitative and whose focus is student satisfaction will have a different view from someone whose approach was based on open dialogue, whose analysis was qualitative and whose focus was undergraduate learning. Just as importantly, those whose understanding of and beliefs about teaching and learning are based on espoused theories will inevitably have a different perspective on teaching and learning from those who base their understanding on what students report is the situation they experience in practice.

I hope the recommendations stemming from this research might contribute towards programme quality enhancement and, more particularly, to a

different understanding within the Department and perhaps the University of students' perspectives. For this to happen, however, staff would need to engage critically with the data, even if not with the analysis offered here. However, two observations lead me to believe that staff may not (for whatever reason) engage with research into students' experiences:

- Firstly, no-one from Teaching and Learning at the University of Bath attended the SRHE Annual Conference in Bristol in 2004 (participant list, December 2004) and their names do not appear on emails from the SRHE Student Experience Network (2005) or from the British Educational Research Association, Higher Education Special Interest Group (2005).
- Secondly, when the Department hosted a day on Enhancing Teaching-Learning Environments in Undergraduate Courses, based on research with the Departments' own staff and students, only three out of their forty-five academic staff attended, less than 7% (HE Academy Centre for Bioscience delegate list and Departmental web pages, June 2005).

A unique contribution?

Methodology

There is a fashion for surveying undergraduate opinions. There are, though, serious limitations to this approach, in that it may fail to reveal problems and cannot reveal *why* students perceive their undergraduate experiences in the way that they do. Qualitative data, in which students are encouraged to say what is important to them, is richer in this respect. Entering into open dialogue with students, face to face or by email, proved to be a fruitful method of gathering data. Email had particular advantages as a research tool as it gave ready access to students, with the added bonus (for students on placement abroad) of transcending time zones; it provided a permanent written record of student data without the need for transcription and, being used informally by a generation of students accustomed to 'texting' their friends, produced written words very similar to dialogue in nature. Rich and varied qualitative data can, however, be confusing to interpret and require a

powerful analytical approach to make sense of them. My claim is that an analytical framework based on Socio-cultural and Activity Theory in combination with consideration of espoused theories and theories-in-use in real learning situations, is a useful and informative approach which leads to greater understanding and could point the way towards programme enhancement.

The framework (p 214) is relatively simple and may even appear simplistic; reducing the work of Vygotsky and other theorists to a very few categories (Activity, Mediation, Learner Individuality and Learning Outcomes) seems disrespectful to their genius. Yet, these categories are powerful and, when combined with Argyris and Schön's Theory of Action, the result is a useful tool for thinking about the complexity of learning situations and one which, I feel, may be readily accessible and widely applicable.

Placement learning

Placements are often viewed as vocational work experience for the acquisition of skills for use in future employment; in this view, the provision of placements can be a numbers game whereby placements are seen as adequate as long as they meet certain minimum requirements. I hope this study has demonstrated the value of the alternative view of placement work as an opportunity for student engagement in meaningful activity with high quality supervision within a cultural environment that can help towards the fulfilment of an individual's potential as a useful member of society, lifelong learner and ethically mature human being. From this perspective, the nature of placement work, its supervision and cultural ethos are seen as vitally important and only high quality placements are acceptable.

University-based learning

University views of lectures, practical classes, seminars, tutorials and so on are all too frequently one-sided, with learners' views of their learning rarely taken into account to any great degree. However, when students' views are

explored and analysed it is possible to identify areas where university time and money is currently invested with, to judge by students' evidence, very poor learning outcomes ('waste of time', 'learnt nothing'). I have tried to make an evidence-based case for universities to do less in some areas, more and more-effectively in others; I have identified ways in which lectures, practical classes, seminars and tutorials might be improved, without additional costs or with cost savings. Finally, and crucially, I have advocated an ethos which has concern for students' perspectives and emotions, is less judgemental and more supportive and has higher aims for its students than merely the acquisition of skills.

Learning and teaching concepts

The vast majority of the concepts in this research come from literature on education. There are just two which may be new. The first concept is the *potential for learning* within each learning situation; it encompasses the ideas of Mediation (support and messages), Learner individuality and the Object of learner activity and how they are likely to impact on Learning outcomes. The second is the idea that good teaching *approximates to natural human dialogue.* For example, the closer a lecture approximates to normal inter-personal interaction, the more students tend to engage with the lecturer and the lecture: 'It just keeps your attention so much longer if somebody's actually speaking to you … it's their own words. You can concentrate more'.

A new model of Socio-cultural and Activity Theories

With the help of research participants, I derived a model of learning based on a range of Socio-cultural and Activity Theories (in Chapter 5). Its imagery (including equations, a DNA-like double helix and cell culture) comes from Molecular and Cellular Biology. It will not, of course, resonate with everyone but apparently does with some people, particularly those with a Bioscience background. Being essentially a simple model, it might prove to be a useful shortcut for Bioscience teachers to consideration of those aspects of learning and teaching which socio-cultural theories tell us are important.

Personal postscript

All the data presented in this thesis have come from the experiences of others, not from my own. However, I have been a student at the University of Bath for 8 years (four as an undergraduate studying Molecular and Cellular Biology with the Department of Biology & Biochemistry and four as a postgraduate student with the Department of Education). This has been a major strength in my research but, of course, could also be seen as a major shortcoming and, although I have attempted to bracket my own views as far as possible, one can never quite do that. In part, I *feel* like a student. I have been an undergraduate representative on the SSLC and postgraduate academic representative on the Graduate Studies Committee. It was and remains my view that students have little voice within the University.

I have also been a member of staff for $4^1/_2$ years (as Placements Tutor with the Department of Biology & Biochemistry and Research Officer in the Department of Education) and I know that my colleagues are well-intentioned and believe they would like their students to have the best possible quality of learning experiences. I hope that, by putting together a comprehensive narrative of students' perspectives of degree programmes in one subject, I may help the University towards an understanding of what is important to students and what might help to improve the quality of their experiences in other subject areas too. It would be a bonus if the analytical approach derived here was adopted to enhance students' experiences more widely.

This research was self-funded and carried out by someone who, as a student-insider, just happened to care passionately about the quality of students' learning experiences. It was, of course, a small project but topical; there is currently much talk of 'the student experience' (e.g. the Society for Research into Higher Education has a Student Experience Network, of which I am a member). However, there has not, to my knowledge, been much *analysis* and I think it unlikely that the sector will gain further insight into students' perspectives of their learning without funding more analytical research. I do not claim that the understanding or analytical framework,

derived through this research project, are the only or best ones; far from it. My own understanding, and that of others, would be enriched by considering differing views on undergraduates' perspectives of their learning.

Poppy Turner
November 2005

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Appendix 1, MCB programmes specifications

Copied from http://www.bath.ac.uk/bio-sci/mcbprogspec.htm [31/8/05]

Programme Specification for BSc (Honours) Molecular & Cellular Biology BSc (Honours) Molecular & Cellular Biology (with placement) MBiol (Honours) Molecular & Cellular Biology

GENERAL INFORMATION	
Awarding Institution/Body:	University of Bath
Teaching Institution:	University of Bath
Programme Accredited by: (inc. date of accreditation)	Not applicable
Programme approved by: (inc. date & min. no. of Dept, FBoS, QAC, Senate)	Approval of MBiol in Molecular and Cellular Biology: Board of Studies 22.11.2000, Senate 13.12.2000
Final Award:	BSc (honours) Molecular & Cellular Biology MBiol (honours): Molecular and Cellular Biology
Programme Titles:	BSc (honours) Molecular & Cellular Biology (Full time over 3 years) BSc (honours) Molecular & Cellular Biology (3 years full time plus 1 year professional training placement) MBiol (honours): Molecular and Cellular Biology (Full time over 4 years)
Programme Codes:	USBB-AFB05 [BSc 3year] USBB-AKB05 [BSc 4year] USBB-AKM05 [MBiol]
UCAS Code (if applicable):	C130 [BSc 3year], C131 [BSc 4year], C132 [MBiol]
Subject Benchmark Statement:	Molecular and Organismal Biosciences
Intended Level of Completed Programme: (in line with NQF)	BSc (Honours): H level MBiol: M level
Duration of Programme and mode of study:	See Programme titles
Date of Specification preparation/revision:	24/6/2002 Dr C M Todd

SYNOPSIS AND ACADEMIC COHERENCE OF PROGRAMME:
The programmes in Molecular & Cellular Biology are based at the Claverton campus, which provides teaching accommodation, laboratory space and a Library and Learning Centre that meet the needs of the programmes. The programmes are designed to allow students to understand, analyse, practice and evaluate the knowledge and skills of a range of biological areas. Those undertaking a professional training placement will also gain experience of application of their knowledge and skills in a professional context at the placement location. The first year is common to all students, providing grounding in the major themes of modern molecular and cellular biology. The second year includes a range of options available to allow specialisation and an additional course in bioinformatics for MBiol students. For the third year, students on BSc Molecular & Cellular Biology complete their degree through choice of taught units, most at honours level but options to take a limited number of Masters

level units. There is also an Honours level project. Those on BSc Molecular and Cellular Biology with placement undertake this same final year after one year of professional training. MBiol students must undertake a professional training year in a research environment. During this year MBiol students will undertake additional units in problem solving and critical reading. The final year of MBiol Molecular & Cellular Biology involves a final year (Masters level) project, research training and an integrative molecular & cellular biology unit plus further units in specialist areas, most or all of which are at Masters level.
Particular features of these programmes are:
- based on a leafy campus at the edge of a World Heritage City
- the department has a record of excellent teaching and research, which continues to improve
- well established and in a growing area of the biosciences
- a long history of close links with employers, that provide our students with practical experience of being a professional scientist

EDUCATIONAL AIMS OF THE PROGRAMME:

We aim to:

- offer a stimulating environment that will encourage students to develop their full academic potential
- instruct our students in ways of approaching and analysing problems, so that they can reach considered and appropriate conclusions, and communicate these conclusions to others
- equip students with skills that are both of value to future employment in some area of biology and transferable to other avenues of employment
- provide conceptual and factual knowledge of core aspects of biological sciences and supporting disciplines and explore the boundary of knowledge in selected areas

An additional aim of the MBiol is to:

- prepare graduates to be able to undertake a professional, research-related career in biology with the minimum of further formal training

INTENDED LEARNING OUTCOMES (inc. teaching, learning and assessment methods):

Teaching, Learning and Assessment methods are employed that enable the learning outcomes to be demonstrated. There are lectures, tutor-led seminars and tutorials, student-led seminars and tutorials, practical sessions, field trips, workshops, practical project, problem solving classes, research seminars and professional placement. Students are encouraged and supported in developing an independent learning style to maximise their academic performance and enable them to take advantage of lifelong learning opportunities.

Assessments include unseen examinations, practical reports, essays, oral & poster presentations, data interpretation, problem solving, placement report and project report.

At the end of the programme, all students will be able to:

Knowledge and understanding:	• Demonstrate understanding of the fundamental concepts, principles and theories of modern biology • Illustrate a sound knowledge of the major areas of molecular & cellular biology • Illustrate a knowledge, in a few areas of specialisation, of the current developments in molecular & cellular biology • Demonstrate a level of knowledge and understanding sufficient to secure employment or enter and benefit from further instruction in molecular & cellular biosciences or related areas, through formal higher degree or vocational

	programmes In addition, students who have undertaken placement will be able to: • Demonstrate a knowledge and understanding of an area of professional practice In addition MBiol students will be able to: • Demonstrate additional in depth knowledge and an awareness of current problems at the forefront of their specialist area of molecular & cellular biology
Intellectual Skills:	• Find and assimilate new information and address many kinds of problems using scientific methodology • Integrate and evaluate information and data from a variety of sources in order to gain a coherent understanding of theory and practice • Formulate and test hypotheses • Apply professional judgement to balance risks, costs, benefits, safety, reliability, aesthetics and environmental impact • Evaluate critically the evidence underlying current theories and hypotheses In addition MBiol students will be able to: • Tackle and solve problems with self-direction and originality • Evaluate critically current research and new methodologies in their specialist area
Professional Practical Skills:	• Undertake competent, safe, evaluative, reflective and effective laboratory work • Analyse experimental results and determine their strength and validity • Able to act autonomously, with minimal supervision or direction, within agreed guidelines • Apply pedagogical knowledge to understand the processes underpinning molecular & cellular biology and so be able to direct motivation in relation to learning and performance • Research and present accounts of currently active areas of some aspects of molecular & cellular biology • Continue to learn through further training of a professional or equivalent nature In addition MBiol students will be able to: • Act autonomously in planning and implementing tasks at a professional or equivalent level • Learn independently as required in a professional context
Transferable/Key Skills:	• Communicate effectively with a wide range of individuals using a variety of means • Work effectively individually or as part of a team

	• Utilise problem solving skills in a variety of theoretical and practical situations • Plan and organise their time to ensure that all tasks are completed and deadlines met • Learn in familiar and unfamiliar situations with open-mindedness and in the spirit of critical enquiry • Use computers for communication, data handling and word processing

STRUCTURE AND CONTENT OF THE PROGRAMME (inc. potential stopping off points):

Year 1
The three programmes in molecular & cellular biology follow a common first year with units covering areas of biochemistry, cell biology, diversity, introductory organic chemistry, cell & molecular biology, genetics, human physiology and either further biological diversity or general chemistry. There are also two half units in skills & techniques. Units have a credit value of 6, with each student taking 60 credits over an academic year that consists of two 15-week semesters. Additional units in education, management or a foreign language may be taken.

Year 2
The programmes have a common second year, with students again taking 60 credits. All courses have two mandatory half units, Directed studies, and three mandatory 6 credit units, DNA (making , breaking & disease), Cell biology 2 and Practical molecular biology. A further 6 units are selected from options available including genes & development, physiology & immunology, plant pathology, plant biochemistry, plant biotechnology, bacteriology, microbial genetics, statistics, enzymology, physical biochemistry & proteins, protein purification, cellular neurobiology and genes & development practicals. MBiol students will also do a pre-placement course in bioinformatics.

Year 3
Optional professional placement year for BSc students involving a minimum of 44 weeks experience within a professional setting. Mandatory professional placement for MBiol students involving a minimum of 44 weeks experience in a research environment. Additionally there are two units, problem solving and critical reading, to study whilst on placement.

BSc Final Year
Mandatory in the final year is an investigative project and a unit on data interpretation. The remaining 42 credits are selected from the units available, which build on and develop from those offered in year 2. Most units are at H level, though a limited number of M level units are also available.

MBiol Final Year
Mandatory in the final year is an M level research project and units on research training and integrating biological concepts. The remaining units (36 credits) are chosen from a range of options, which build on and develop from those offered in year 2. Most or all of these units are M level.

Current actual unit titles and descriptions can be access from
http://www.bath.ac.uk/catalogues/2002-2003/bb/bb-proglist-ug.htm

DETAILS OF WORK PLACEMENTS/WORK BASED LEARNING/INDUSTRIAL TRAINING/STUDY ABROAD REQUIREMENTS:

For the four year BSc and for MBiol, students must undertake a professional placement in an area of biological sciences. The placement is an integral part of the learning and teaching process of these degrees. The placements allow the students to apply their knowledge and skills in the work place, as well as further develop these through their new experiences. Placements for MBiol students are of a research nature, thus developing critical reasoning and data interpretation skills. These skills are concurrently developed through the study units taken by MBiol students whilst on placement.

Placements are arranged through the Departmental placements officer and assistants. Example placement institutions include, AstraZeneca, Bayer Crop Protection, Baylor College of Medicine, CAMR, Chiron (USA), University of Colorado, Duke University, EMBL/ESRF, Emory University, Florida University, Gensys Ltd., GlaxoSmithKline, GR Micro, Institute of Cancer Research, ICH at Gt Ormond Street, University of Illinois, University of Kentucky, Lilly, Merck, Sharp & Dohme, Novartis, Pfizer, St. Jude Children's Hospital, Syngenta, Unilever/Unipath, University College London, Vernalis, Wake Forest University, University of Western Australia, Wickham Laboratories. A significant number of MBiol placements can be taken outside of the UK.

The placement is assessed by a detailed report on the placement work (approx. 20-50 pages) and an assessment by the employer. Additionally, upon return to university students are required to present a poster display of their work at a placement conference, which is open to academic staff and all undergraduates of the department. This poster is assessed for those students taking MBiol. Successful completion of the placement is required for endorsement of the BSc with placement, but the grades (distinction, merit, pass) do not count towards final degree classification. For MBiol students the placement assessment contributes to the final degree classification.

DETAILS OF SUPPORT AVAILABLE TO STUDENTS (eg induction programmes, course information, resources):

- University and Department Induction Programme
- Programme handbook
- Unit descriptors
- Study Skills Support
- Excellent Library and IT facilities
- Sports and Arts facilities
- Proactive Students' Union
- Guaranteed 1st year accommodation
- Medical Centre
- Dentist
- Counselling Service
- Careers Advisory Service
- Learning Support Service
- Chaplaincy
- International Office
- Personal Tutorial System
- English Language Tuition
- Nursery facilities
- Placement visits and support
- Access to Tutors and Support Staff
- Staff/Student Liaison Committee
- Research Project Handbook

ADMISSIONS CRITERIA (inc. arrangements for APL/APEL):

Candidates must be able to satisfy the general admission requirements of the University of Bath and the Department of Biology & Biochemistry. These include:

- Five grade 'C', or above, GCSE passes, or equivalent, which must include Maths, English language and a science
- Non-native speakers of English must have a suitable English Language qualification [e.g. IELTS 6.0, TOELF (paper) 550, TOEFL (computer) 213]

Plus one of the following:

- Three subjects at A2, which must include chemistry and biology. One of the other two subjects must be another science or mathematics. Typical grade requirement

ABB/BBB.

- BTEC: An appropriate National Diploma with Distinction in appropriate units
- Irish Leaving Certificate with an appropriate range of subjects (typical grades AABBBB)
- Scottish Advanced Highers in two subjects (typical grades BB) plus Highers in five subjects (typical grades AABBB)
- GNVQ: Typical requirement for Distinction at Advanced GNVQ
- HND in appropriate subject
- International Baccalaureate: Typical requirement for 34 points with at least 6 in HL biology, 6 in HL chemistry and a suitable range of other subjects
- Foundation/Access course: Suitable courses with appropriate subject balance and standards
- An equivalent qualification from a recognised awarding body

Mature and overseas students will be considered on an individual basis.

Accreditation of Prior (Experiential) Learning is considered on an individual basis, please contact the Biochemistry/MCB Admissions Tutor for discussion.

QUALITY ASSURANCE MECHANISMS: (eg mechanisms for review/evaluation, quality committees, staff development):

QUALITY ASSURANCE MECHANISMS: (eg mechanisms for review/evaluation, quality committees, staff development):

- Unit Evaluations
- Student Feedback Questionnaires
- External Examiners' Reports
- QAA Subject Review
- Periodic review of programme (Degree Scheme Review)
- Annual Programme Monitoring (Director of Studies report)
- Annual Staff Appraisal
- Peer Observation of Teaching
- Internal Moderation of Assessment and Boards of ExaminersØ Placement Progress Reports
- Institutional Staff Development Programme
- Learning & Teaching in Higher Education Programme for all new lecturers
- Regular programme (Teaching Committee) meetings
- Staff/Student Liaison Committee
- Departmental Committee
- Departmental Courses Committee
- Departmental Quality Assurance Committee
- Faculty Teaching & Quality Committee
- Faculty Board of Studies

ASSESSMENT AND PROGRESSION REGULATIONS:

Year 1 - assessment is for progression to the second year. Normally an overall mark of 40% will be required for progress to year 2. Students must normally pass all units. Supplementary assessment in the summer vacation will be allowed for students failing to achieve the required unit marks. Marks from the second and final year contribute to the degree classification. The marks for each unit are weighted according to the credit weighting, the level of the unit and the type of unit.
For the BSc courses the weightings of marks contributing to the degree from Years 1, 2 and Final Year are 0%, 30% and 70% respectively, with the final year marks being made up of project (14%) and other units (56%). The placement will not influence the BSc degree classification. An assessment of distinction, merit or pass will appear as an endorsement alongside the degree certificate.
For the MBiol course the weightings of marks contributing to the degree from Years 1, 2, 3 and 4 are 0%, 20%, 18%, and 62% respectively. Year 3 is made up from taught units (12%)

and the placement assessment (6%). The final year is made up from project (20%) and other units (42%).

Summary of grades, marks and their interpretation for honours degree classification:

70% or greater	First Class Honours
60-69%	Upper Second Class Honours
50-59%	Lower Second Class Honours
40-49%	Third Class Honours

An overview of the assessment details is provided in the student handbook. A full assessment brief is provided within the unit guide and final year research project handbook.

INDICATORS OF QUALITY AND STANDARDS (eg professional accreditation, QAA Subject Review results):

The Department of Biology & Biochemistry is a broadly based department with academic staff specialists in a diverse range of biological subjects but grouped in six main research areas; animals, cells, evolution, microbes, molecules, plants. The Department achieved a grade 5 in the Research Assessment Exercise (2001) and maximum points of 24/24 in the Quality Assurance Agency Subject Review held in October 1999.

The department has links with The Biochemical Society and other learned societies for professional life scientists. Also, through the research collaborations and the placement of students, it has close links with industry and other academic departments both in the UK and abroad. These close associations feed into the degree programmes, keeping them up to date and relevant to the needs of employers and academic research.

EXAMPLES OF OPPORTUNITIES AVAILABLE TO STUDENTS ON COMPLETION OF PROGRAMME:

The department has a good record for employment and further study by it graduates, who enter a range of professions, both linked and unlinked to the specific subject area. Those graduating with MBiol will be prepared for further study at research level with the minimum of further training.

Further details can be obtained at http://www.bath.ac.uk/careers/destinations/biology.pdf

SOURCES OF OTHER INFORMATION:

Further information can be found on the Departmental web page http://www.bath.ac.uk/bio-sci/

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Appendix 2.1. Questionnaire for graduates of Group G

Just a little bit of boring background.

My research will look at how students feel about their time with Biology & Biochemistry at Bath. I want to know how people learn in a university setting including, for those who chose it, from doing a placement.

When I say I am interested in 'learning' I don't mean it in a subject-and-exam sort of way. I mean learning, growing, maturing, developing in the widest sense so … learning about life, the universe and everything is fine for my research if that's what you want to tell me about.

Each contributor will be anonymous or given a false name in my dissertation.

I want to know what might be the important concerns for my study group of new MCBs who have just joined the Department.

Questions about your time as an undergraduate in Bath

1. Why did you choose MCB and why Bath? Did the placement option figure in your decision?

2. What did it feel like to come to university? What was it like to leave home? Did you relish the freedom or were you homesick?

3. Lectures are very different from school lessons. Did you notice any difficulties with the transition?

4. How did you find lectures/lecturers' styles?

5. Did you learn a lot from lectures?

6. Did you find it easy/difficult to take notes? Were your notes helpful when it came to revision?

7. How did you find practical classes?

8. Regardless of eventual marks - how did you find exams?

9. Do you have any tips for revision? Any tips for surviving exams?

10. Was your tutor helpful? How did you find tutorials?

11. Did you cope with the workload and manage your time OK? Any tips?

12. What made you decide to do or not to do a placement?

13. What did you expect from a placement and did you get what you expected?

14. Where did you do your placement and what was the work like?

15. Was the placement experience a good one/beneficial?

16. Did you learn a lot – learning in its broadest sense – learn something about life as well as MCB-related? Subject learning in context, maturity, independence, time management, communication skills – what words would **you** use to describe the effect a placement had on you?

17. Was any of the placement experience bad? Were you homesick, out of your depth?

18. Were you able to fit in the social side of life at university?

19. Do you look back on your time as a Bath undergraduate as a positive or negative experience overall?

20. What do you think would have made it more positive/less negative?

21. Do you have any tips for the new students on how to survive and maximise the experience?

22. Did your time in Bath adequately prepare you for what you went on to do? What are you doing now? Do you wish you had not done a degree in MCB or done it differently?

Thank you. I really appreciate your help.

Appendix 2.2. Immediately retrospecitve

Questions on your placement year, 2001-2002

Some of these questions are somewhat similar, I'm afraid, as I have rephrased some things to get the best possible data out of your responses. Just put the cursor under the question and write as much as you like.

1. Did you have your own project on placement or not really, not much of one?

2. Would you describe your placement work as mostly routine or was it quite challenging? What words best describe the nature of your work?

3. Did your placement work involve you in lots of different things, i.e. give you a breadth of experience, or a few things in great detail, i.e. requiring you to become an expert in a limited field?

4. Did you learn practical/laboratory MCB-related skills and techniques? If so what type of things **and** how does this compare with practical classes at university?

5. Did you gain MCB-related knowledge and understanding? If so how does this compare with learning from lectures and university-based practicals?

6. Did you have time to do any background reading and/or to think about the work you were doing or was it more a case of just getting the job done?

7. Did you gain work-related skills (I'm thinking of things like IT or team working but there are loads of others)? If so what type of skills?

8. Do you think of your placement as 'work experience' or was it also a useful contribution to your academic studies?

9. Describe the atmosphere/culture/ethos of your placement environment.

10. Describe your supervisor(s) **and** your relationship with them.

11. Did your placement change you in any way? If so how?

12. What were the positive aspects of your placement and what could have made it more positive?

13. What were the negative aspects of your placement and what could have made it less negative?

14. Do any emotion-laden words spring to mind in relation to your placement year? (I'm thinking of loneliness, disorientation, friendship, glad or sad to leave etc., anything that comes to mind really.)

15. Do you think you gained any confidence, maturity or independence?

16. If your placement was a beneficial experience, could you say whether you gained most practically, academically, professionally or personally? Use your own words to describe the effect the placement had on you.

17. If the placement, or any part of it, was unpleasant could you explain how and why it was bad?

18. At the end of second year did you understand what a Molecular Biologist is or does? Do you have a better idea now and, if so, did your knowledge come from doing a placement?

19. Do you feel the same or different now about being a Molecular Biologist or what you want to do or be after graduation?

20. Do you think it helped your learning in some way to be situated in the placement environment? Perhaps working with others, having role models, becoming familiar with the language and mind-set of your placement group might be helpful – what do **you** think was helpful?

21. Some people believe that learning in context cannot be transferred to other contexts. Do you feel as if your placement learning will or won't help you in future situations?

Please add anything else which I have left out but which you think is important.

Thank you very much for taking the trouble to answer these questions. I really appreciate your help – I couldn't do a PhD without it!

Appendix 2.3. Questions emailed to first year MCBs who didn't come to the meeting held on October 2001

1. Why did you choose the MCB course and why Bath?

2. Did the option to do a placement influence your choice at all?

3. What did it feel like to leave home and come to university? Do you like the freedom or are you homesick?

4. You are a successful learner (you proved it by getting a university place). What was it about some lessons which worked best for you and what didn't work so well?

5. If you had practical classes at school, what did you think of them?

6. Did you find exam revision OK? Did you have a particular revision method?

7. Did you have a gap year, are you a mature student and do you have more than a couple of weeks work experience?

8. Lectures are very different from school lessons. Are you having any difficulties with the transition to lectures?

9. What do you think of lectures and different lecturers' styles?

10. Do you feel as if you are learning a lot from lectures?

11. Did you find it easy or difficult to take notes?

12. How are you finding the practical classes?

13. Have you met your tutor yet? If so, what are your first impressions? Have you had a tutorial?

14. Do you think you'll be able to cope with the workload this year?

15. It's early days yet (and these things can take time) but have you made any friends, joined any clubs, begun to have a social life?

16. Do you think you will manage to fit in both work and a social life?

17. What are the especially good or bad things about your first few weeks here?

Appendix 2.4. Questions mid-first year, February 2002

1. MCB wasn't the first choice of degree for all of you. How do you feel about being on the MCB course?

2. Do you feel as if you've settled in now?

3. Do you feel the MCBs have group identity?

4. What did you think of lectures last semester? What helped you learn, what didn't work so well?

5. Were you happy with your note-taking technique?

6. Were you given any guidance on how to learn?

7. Did you do much background reading?

8. What about practicals?

9. Is the practical work related to what you're doing in lectures?

10. How are you getting on in tutorials? Are they helpful?

11. Did you fill in feedback cards last semester? Was it a good method of collecting your views?

12. A couple of you said you struggled with revision at school. How did you find it this time?

13. How did you find the exams?

14. Did you cope with everything you had to do last semester?

15. Did you have time for a social life of some sort?

Appendix 3.1. FIRST DRAFT FRAMEWORK FOR ANALYSIS

What is learnt, including the nature of placement learning

Laboratory and MCB-related skills – list

Work related skills – list
IT skills, presentation skills, team membership, working independently,
interpersonal skills

Academic understanding
Internalisation, cementing theoretical knowledge through doing (repeatedly) and reflecting

Professional knowledge
Reflection on practice, experimental design, ways of knowing, thinking, analysing, critiquing and behaving as a professional
Ref both above, depth of knowledge/understanding in specific area and expertise

Personal attributes/growth
Maturity, independence, confidence, motivation, taking responsibility

Incidental learning
Positive or mis-educational

Transformational learning
Changes in life-world perspective, self-knowledge/metacognition
Views of self
Views of self as a learner
Views of self in relation to the rest of the world

How does this learning come about?

Phase of students, their attributes – maybe this is a factor?

Dis-equilibrium, dis-junction – does this help learning?

Nature of work
Repetitive or seen as challenging

Engagement with that work vs alienation
Ownership, "own project", given some independence, proper job – does this influence learning outcomes?

Relationships with supervisors

How significant are good or bad relationships and what constitutes 'good'/'bad'

Immersion in culture/ethos, relationships within groups

Language/jargon – they use lots of MCB jargon quite quickly (but this is of limited use in a thesis on learning, which might have broader implications. One lad said he was 'acclimated', one girl wrote of having to 'start over', after only a couple of weeks in the States). Use of tools – real and psychological (cannot separate), communities of practice

Becoming an expert

Role model, gradual withdrawal of scaffolding, from fringes to centre of field of expertise

Experiential/problem-based

<u>Links/relationships between what is learnt and how?</u>

?Greater dis-equilibrium with greater learning? Especially learning in one area? Personal perspectives etc??

?Own project and/or greater independence with more happiness and greater success - Quote from Davies on happiness and success, p 37

Good relationships and/or scaffolding with better learning

Stress/pressure with surface and relaxed atmosphere with deeper approaches?

High calibre institutions with lower learning? (Maybe. Ref Harvard, ESRF and Max Planck)

Respect for colleagues with desire to do well and perhaps to continue in the field, do PhD??

Appendix 3.2, SECOND DRAFT FRAMEWORK FOR ANALYSIS

What is learnt, including the nature of that learning

Laboratory and MCB-related skills

Work related skills

IT skills, presentation skills, team membership, working independently

Interpersonal skills

Academic understanding

Depth (Marton and Saljo). Internalisation, cementing theoretical knowledge through doing and reflecting. Transferable?

Professional knowledge

Deep (Marton and Saljo). Reflection on practice (Schön), experimental design, ways of knowing, thinking and acting/practising (McCune et al)

Personal attributes/growth

Maturity, independence, confidence, motivation, taking responsibility

Transformational learning/Self-knowledge/metacognition (Ref)

Changes in life-world perspective View of self, View of self as a learner, View of self in relation to the rest of the world

How does this learning come about? By what **process**?

Phase of students, their attributes – maybe? Preparedness (Piaget)

Dis-equilibrium, dis-junction (Paiget. Mezirow? Lewin?)

Nature of work/task/goal. Meaningful/purposeful activity (Moscow – Activity Theory?) and engagement with it.

Repetitive or seen as challenging

Relationships with supervisors (Socio-cultural, Instruction, Apprenticeship (Vygotsky, Rogoff, Lave?). Attributes of supervisors

Method of instruction. (Moscow and Bruner?)

Scaffolding and its gradual withdrawal (Woods, the ZPD review article ?&?) Engagement in meaningful/purposeful activity.

Immersion in culture/ethos, relationships within groups

Language/jargon – they use lots of MCB jargon quite quickly (but this is of limited use in a thesis on learning, which might have broader implications. 'acclimated' 'start over'

use of tools – real and psychological (cannot separate. Activity theory), community of practice (Lave). Is a community of practice the same as an activity system??
Is this immersion, this learning by osmosis, also incidental learning (positive or mis-educational? Dewey)

Becoming an expert

Role model?, Scaffolding and its gradual withdrawal, from fringes to centre of field of expertise. Community of practice again.

Experiential/problem-based, learning by doing – purposeful activity? (Activity theory – keeps cropping up!) Is problem solving the quintessential purposeful activity? (Moscow school, Donald Woods, Howard Barrows.) Where does learning from mistakes come in?

Links between what and how? Is this going to identify factors which facilitate learning and its inhibitors?

?Greater dis-equilibrium with greater learning? Especially learning in one area? Personal perspectives etc?? Think about how much is good and how some could be counter-productive.

?Own project and/or greater independence with more happiness and greater success - Quote from Davies on happiness and success, p 37. Um, happiness and purposefulness? Related?

Good relationships and/or scaffolding with better learning

Stress/pressure with surface and relaxed atmosphere with deeper approaches? – I think this has been proved by some of the student-centred people – Marton and Saljo? Ramsden? Entwistle? Students refer specifically to 'Motivation' ref laid back working atmospheres.

High calibre institutions with lower learning? (as I've observed with Harvard, ESRF and Max Planck). Maybe supervisor too driven to provide scaffolding? More self-directed learning is supposed to be good!

Respect for colleagues with desire to continue in the field, do PhD?? Role modelling.

Social life a factor? Peers or happiness? Affective effects?

Happiness and better learning? Conflict with the idea of dis-equilibrium – how about manageable discomfort and that which overwhelms?

What implications, social interactions and IT? (I know it's socio-culturally influenced but …).

Appendix 3.3, THIRD DRAFT FRAMEWORK FOR ANALYSIS

1) REGARDING THE *POTENTIAL FOR LEARNING*, in the learning situation (equates to quality of learning situation?)

THE QUALITY OF WORK / ACTIVITY

- Did the placement experience involve some degree of dis-equilibrium?
- Was the placement work menial, repetitive and boring or challenging, interesting, even exciting?
- Was the work within the student's capacity to achieve, with initial help, or overly difficult and stressful?
- Was the work engaging and meaningful from the student's perspective? (Was a personal project available?)
- Was there opportunity for the student to become familiar with a range of tools and techniques, associated with the placement field of work?
- Was time available for background reading and reflection?

THE QUALITY OF SUPERVISION / INSTRUCTION

- Was a supervisor available, approachable and enthusiastic about the work?
- Was some capable person(s) available to demonstrate techniques, to answer questions and to support the student until s/he developed some skill and confidence?
- Was the student encouraged to work independently once able to do so?

THE NATURE OF SOCIAL INTERACTIONS AND THE WIDER CULTURAL ETHOS (quality of learning environment?)

- Was the student valued and respected and was someone available to monitor the student's social and emotional wellbeing and offer support if necessary?
- Was there potential for some social life or was the student lonely and isolated much of the time?
- Did the opportunity exist for the student to be included in a community of practice, become immersed in the culture of their placement institution, to learn the language and the ways of thinking and behaving in a professional environment?

2) REGARDING THE NATURE OF *LEARNING OUTCOMES* ACHIEVABLE

SKILLS AND COMPETENCIES, know-how.

- MCB-related skills, techniques etc.
- Work-related skills, e.g. IT, presentations skills, team working, communications skills.

ACADEMIC AND PROFESSIONAL COMPETENCE, knowing that.

- Learning to communicate scientific information (writing, presentations).
- Data interpretation/analytical thinking, planning experiments.
- Developing deeper understanding, internalising, becoming an expert.
- Reflective practice.

REALISING GREATER PERSONAL POTENTIAL, moving towards becoming the best that individual can be.

- Growth or development in personal attributes, maturity, independence, self-motivation.
- Changes in life-world perspectives.

3) WHAT LINKS ARE THERE BETWEEN THE PLACEMENT SITUATION AND THE LEARNING OUTCOMES?

Categories in 1) and 2) seem fairly certain, although subject to change in the light of future research findings. The major thrust of the longitudinal study will, therefore, be in this area of possible links between categories. For example, is it possible to discover whether placements abroad, likely to involve higher degrees of dis-equilibrium, are advantageous to learning? Do positive mental attitudes towards placements, on the part of the student, tend to predispose to greater placement success? How direct is the link between the quality of work undertaken and the quality of learning outcomes? Good supervision seems to facilitate placement learning but does it merely make learning easier for the student or does it affect the learning quality? Does lack of supervision, its gradual withdrawal or the requirement to fulfil a challenging project tend to lead to greater independence? Do good social and cultural interactions aid professional and/or personal development?

These sorts of question underlie the next phase of research.

Appendix 3.4, FRAMEWORK BASED ON PRELIMINARY RESEARCH

- Activity (related to object, goal, purpose, intention, motivation):

  Which activity are the students really engaged in, in practice?

- Local and Wider-cultural Mediation (related to emotional support, support for learning, direct and indirect human interactions, language, texts, signs, tools, psychological tools, cultural ethos):

  What support do students receive and what messages are they exposed to?

- Learner Individuality (innate ability, attributes, personality, background, experience, perceptions):

  How do students perceive and react to their learning opportunities?

- Learning outcomes:

  What is the effect of the factors listed above on students' learning?

Appendix 4: Recommendations on MCB programmes at the University of Bath

These were provided to the Chair of the MCB Teaching Committee in July 2005.

Significance of this research at programme level

In one sense, the recommendations which follow from my research form a partial evaluation of the MCB programmes, in terms of their teaching quality or learning potential. However, the primary purpose of this research was to gain an understanding of undergraduate learning, rather than to evaluate it, and respondents were not questioned about every unit or module, nor about each individual teacher.

Placement-related recommendations

- The nature and quality of placements could be monitored more closely with regard to work/activity, supervision and institutional culture. Placements where the learning potential was low might gradually be dropped in favour of those with higher learning potential; this is a question of academic standards and it might be helpful to have some input from academic staff.

- It is my belief that the quality of the Department's placements could be enhanced if the placements team and the whole department espoused a higher aim for their placements than merely the acquisition of skills.

- The Department might like to consider initiating contact with its students while on placement to check on their well-being and to ensure that it is fulfilling its duty of care in all cases.

- First and second year practical classes could be changed to provide better preparation for practical work undertaken on placement (see forward for specific suggestions from placement students).

- Leaving posters on display until the following Poster Day would provide students with examples of successful formats (formative feedback).

- A clear marking scheme for placement posters would enable students to decide whether or not to invest in expensive lamination.

Undergraduates suggested that having a different type of practical classes in their first and second year would have better prepared them for their placements (their specific suggestions are given under Practical Classes below). Better preparation would have saved one student the anxiety of feeling 'Completely useless' and saved another the only adverse comment (about her lack of laboratory skills) on her supervisors' otherwise-favourable report on her placement.

Research showed that placements were of variable quality and provided high or low potential for learning depending on the nature and quality of the work available, the quality of supervision provided and the cultural ethos of the host institution. Learning outcomes from placements ranged between skills acquisition and transformational personal growth and development. It follows that, if the Department espoused a transformational view of placements and worked towards greater understanding of students' placement experiences (which, on the research evidence, it did not appear to do), it should be possible to weed out the weaker institutions and supervisors (in terms of their ability to nurture student learning) and gradually raise standards. This would necessitate maintaining contact with placement students proactively and either the active pursuit of appropriate placements to replace the few inappropriate ones or having fewer placements to offer. Maintaining regular contact with students on placement would also better fulfil the Department's duty of care in the case of placements which go wrong and help to ensure that paying half fees for placement year was seen as good value for money.

Recommendations on practical classes

- The Department might like to disseminate its examples of good practice in practical classes.

- The Department may wish to collect further student feedback in order to establish which practical units cause student anxiety and what it is about those units that students find stressful; I believe that feedback cards would be inappropriate for this purpose.

- Productive areas for enquiry might include class numbers, preparation for laboratory work, teaching quality, the quality of support offered by demonstrators, the quality of practical handbooks, working atmosphere in the laboratory (Do students feel rushed, even panicked, or is the atmosphere 'More laid back, take your time and do it as well as you can'?) and provision of feedback.

- Another matter which the Department might like to explore is the relevance or otherwise of certain practical subjects to students. Subjects seen as 'A waste of time' might be dropped (see below).

- Consideration could be given to employing professional or properly trained and committed demonstrators. Perhaps provision of constructive feedback for students on their practical work could be one of their duties.

- Specific recommendations from placement students included the following:

    - 'There needs to be a compulsory module just covering molecular techniques. [Not] every one in detail but things like PCR.'

- Students having ‘To think about how to do it and why … making everything themselves … calculating concentrations, splitting cell lines, transfections etc’.

- [Having to do] ‘Dilutions, work out the volumes of enzymes and buffers’.

- In final year, being given ‘A task/outline of experimental aims plus a list of solutions/equipment and some time to develop at least some of the protocol’.

- In the light of the comment above, the Department might like to consider the use of problem-based learning approaches in final year practicals.

Research into MCB practical classes found them to be an area where resources were frequently wasted and that the situation had existed for many years; a 1998 graduate wrote of practicals ‘Almost without exception, a complete waste of time … gave me absolutely no useful training for working in a lab’ and a 2004 graduate ‘The general gist of practicals is that everyone hates them and does them as quickly as possible … no-one cares what they do’. Another participant recommended that ‘Convenors should not cram too much into a lab session - we don’t learn any more by having to rush through lots of exercises, we just get stressed and resent having to do them!’ The word ‘exercises’ hints at the lack of engagement which many students seem to have experienced, perhaps because they failed to see the relevance of some practical work. If, say, Animal Physiology had more relevance for Biology students than students of MCB, perhaps it could become optional, rather than compulsory, for MCBs. This would reduce the number of students taking the unit and enable those who did see its relevance to work in an environment which would be less crowded. It would also, of course, enable the Department to economise on resources.

The loss of some practical courses may not affect students adversely, as they seem to have contributed little, and may benefit students by reducing their stress levels; students said they disliked or were ‘terrified’ of practicals. Staff would have fewer lab books to mark and might find time to provide feedback which was more constructive and informative.

Student stress could be reduced by having smaller classes, by giving more guidance on practical work (through teaching, demonstration, good handbooks and the opportunity to read and understand them in advance of the class), and by supporting the learning of students who struggled; students cannot learn when they are ‘In a muddle all the way through’ or by being given, by copying or by formulating results.

I must point out that the provision of high quality practical classes for undergraduates is a widespread problem. In *Teaching in Laboratories*, Boud, Dunn and Hegarty-Hazel (1986) wrote that physicists from Massachusetts Institute of Technology were so dissatisfied with their undergraduate laboratory courses in the 1970s that they stopped teaching them for a year

and devoted the time to devising new ones. Perhaps it is time for the Department of Biology & Biochemistry to do this in Bath.

Recommendations on lectures

- Compulsory study skills classes might help students and speed up the length of time it takes to develop those techniques necessary for success at university.

- Subjects that students saw as a 'Waste of time' should perhaps be dropped or made optional, rather than compulsory (see below)

- The Department may want to reconsider the view, expressed on its webpage, that its teaching quality is "first rate" in the light of students' views that teaching quality was variable. If teaching quality came to be seen as variable, then steps could be taken to try to raise standards. There are two matters here, one involves the media used to deliver lectures and the other concerns the styles of individual lecturers (see below).

- Consideration might be given to greater use of traditional 'chalk and talk' lectures.

- The use of PowerPoint lectures might be monitored so that good practice could be disseminated and mis-use of PowerPoint minimised.

- Consideration could be given to possible use of webcam technology to deliver lectures.

- If innovative teaching methods are to be introduced, then their use should be researched theoretically beforehand and monitored in practice after introduction to establish their efficacy.

- Where individual lecturers have styles which students find unhelpful, consideration might be given to identifying areas for improvement.

I was quite surprised at the length of time it took some quite able students to develop the study skills necessary to benefit from lectures and to learn effectively from subsequent independent study and revision: 'Took me a good 6-7 months to come to terms with' and 'A shock to go back to study and it took me about a year to get back into it'. Second year revision, but *not* first year, involved 'Actively get[ting] it into your brain instead of just sitting there reading it from a book'. It seems that compulsory study skills (if well taught) might be of help to some students.

The issue of subject-matter relevance was raised with regard to lecture courses and students said repeatedly that having to study subjects which had little relevance to them was 'A waste of time'. It might be better to teach these subjects only to students who are likely to see their relevance. For example, Organic Chemistry probably has more relevance to Biochemistry students

and Biodiversity to Biology students. When compulsory for MCB students, such subjects do not engage them or broaden their minds. Students do, however, have to learn enough material to pass their exams. It may be that this forces them into superficial or strategic approaches to their learning and perhaps gives rise to the resentment expressed by both 1997/8 graduates and participants in the longitudinal study 2001-2005; that both groups raised the matter suggests that teaching such subjects may have been ineffective for some considerable time.

There are two potential benefits which might follow if the compulsion to learn fringe subjects was dropped. The first is a reduction in class sizes (students prefer smaller classes and they reduce pressure on resources) and the second is that students would have more time for their reading. The longitudinal study revealed students' perceptions of work overload, including 'They conspire to stop you reading up on lectures; there's so much else to do' and 'You are happy to do lots of extra reading for your own enjoyment and interest … you'll do more for things that interest you'. It seems that a system involving large numbers of students attending large numbers of lectures may have more to do with teaching efficiency than with teaching effectiveness.

Chalk and talk lectures were praised. They were more successful at keeping students' attention than some PowerPoint lectures yet there was some pressure on academic staff to adopt PowerPoint. Why would a Director of Teaching recommend PowerPoint when all the evidence from students (whether gathered by one of their professors or by me) was in favour of traditional lecturing? Perhaps the Director of Teaching had contradictory evidence or perhaps there was pressure on him? I do not know. I would advocate student-evidence-based practice in this matter because only students can say the effect which different teaching methods have on their learning.

Innovative teaching methods may be an efficient means of disseminating information or 'facts' but are they effective at facilitating student learning? While some innovative teaching methods may require further research before their widespread introduction can be justified, there would seem to be great potential in this area. PowerPoint, when used effectively, can be excellent but perhaps there is a need to define its effective use. Web pages can be a useful source of information when used effectively but again 'effective' needs to be defined. Webcam technology, suggested by one participant, might be an excellent way of getting good lectures into the homes of students and could benefit some groups particularly (mature students with long commuting distances, students with illnesses like ME or glandular fever, hard of hearing students, dyslexics, those who missed the lecture because of project work, interviews, etc). Note, though, that this use of technology does not do away with the need for good quality teaching, it merely delivers it in another way. Those who wanted to attend lectures could do so but those who would rather not could view the lecture and make their notes at home. This would also reduce the pressure on resources. Perhaps the Department might like to look further into these areas as a way of enhancing its teaching provision.

For all the talk of innovative teaching and e-learning, the majority of MCB teaching, particularly in the first two years, is based on traditional lectures. Is there anything that can be done to improve this area? I have suggested reducing the number of compulsory lecture courses, and incidentally reducing class numbers in some lectures, and students have advocated the use of chalk and talk over PowerPoint. What else might help? The data suggest that what students identified as 'good teaching' approximated to normal human interactions and that the further the lecture situation departed from natural dialogue the more likely it was to be seen as poor. Small classes are better than large ones, students felt 'Less isolated', the atmosphere is 'More friendly', 'If somebody's actually speaking to you rather than reading … it's their own words. You can concentrate more', if the lecturer is 'Enthusiastic' and 'Seems to care and know who you are' then students seemed to feel that the lecturer was addressing them personally and that they should engage in what is being said. It follows that people with poorly developed interpersonal skills may not naturally be good lecturers but perhaps observation of those with an instinct for empathising with students, and a talent for engaging them, would help. The greatest asset for a lecturer to have would be the ability to see the subject from the student's point of view and to teach to their level of understanding, aiming always for clarity and eliminating ambiguity and confusion wherever possible.

In terms of the skills associated with good teaching, students mentioned several matters: Lectures should be about the 'Whole picture', the 'Global view', about 'Giving you a framework' and broad principles, rather than 'Everything there was to know on enzymology'. Tharp and Gallimore wrote, in 1988, that lectures were good for 'cognitive structuring'; 'The wise teacher can economically and efficiently provide structures of understanding' (1988 p 63) or schema. Pace was important in lectures; it should be slow enough to allow students to take notes (but not so many notes that this becomes their main activity) and slow enough to allow them to think about the subject matter (but not so slow that they become bored); of course, the answers students give when asked about pace depends on which activity they are engaged in, whether understanding and jotting brief notes or trying to capture the lecturer's every word. Students benefited from being given outline notes in handouts, not detailed ones which discouraged their own input (they tended to memorise such notes and regurgitate them without personal meaning). Diagrams should be as simple as possible and more complex ones 'constructed' in front of the class, by hand or perhaps using PowerPoint animation.

There are many good books which go into this subject in more detail, including *Learning to Teach in Higher Education* (Ramsden 1992). Learning to teach at the University of Bath was the subject of a small amount of data collection from academic staff (Chapter 6 and forward).

I would question the usefulness of peer observation of lectures as it is the students' view of lecturing ability which influences their learning and this cannot always be determined by another lecturer.

Recommendations on the tutorial system

- The Department might like to address the variation between different tutors. It might like to stipulate the amount and nature of set work, the skills students are expected to practice through tutorials and the amount, nature and timing of feedback provision.

- Allowing students some choice in the subject matter of their tutorial work is likely to engage them more than work which is of no interest to them.

- Alternatively, the Department might like to consider different methods of providing pastoral support and support for learning to its undergraduates.

A few tutors were excellent, in terms of the level of care they provided and the sort of work set; students benefited from relationships with these tutors. Others were less good or just too busy to support their tutees' learning to any worthwhile degree. Such tutors are unlikely to respond well to prescriptive interventions. Is there, perhaps, a better way of fulfilling the Department's duty of care and encouraging small group learning? As a suggestion, perhaps the present system whereby many members of staff have a few tutees each could be replaced by one in which a single member of staff looked after all the MCB students; such an arrangement might be effective just so long as that member of staff was someone who cared about students and could dedicate time to them.

Work could be set with the specific intention of helping students towards skills such as sourcing information, writing essays, giving presentations, data analysis, experimental design and critical reading of primary papers. Feedback on this work should be constructive and encouraging of further effort, rather than negative and destructive of self esteem. Group work in a safe and friendly environment, guided by a member of staff whose brief was tutorial-type support, might help students towards a sense of identity and provide an opportunity for peer support which seems to be lacking currently.

Providing students with someone to whom they could 'Let off a little steam!', someone who could act as a 'Whinging outlet', might help them to deal with negative emotions; perhaps this reduces their fragility and increases their resilience. Importantly, such a person might also help the Department towards a better understanding of students' concerns.

Recommendations on seminar presentations

- The Department could consider giving its undergraduates presentation skills classes and experience of presenting earlier in their programmes than the final year, when students are required to present on technical subjects at degree level.

- The destructive effects of a judgemental culture in some seminars could be counteracted by dissemination of good practice, where the provision of

a supportive atmosphere and constructive feedback helped students to gain confidence at presenting and to improve their technique.

- Students (and perhaps staff) might benefit from a clearer definition of the aims of student seminars. Is the primary aim to gain technical scientific knowledge of, for example, phenylketonurea, or is it to gain presentation experience? Are students expected to learn from each others seminars and, if so, are they intended to learn about the subject matter or about presentation skills?

The data strongly suggest that the current system of student seminars often has a detrimental effect on student confidence. It is 'Scary', judgemental and results in students feeling 'Torn apart' and 'Very low'.

I recommend that students are taught, and allowed to practise, presentation skills before having to present on unfamiliar, technical subjects in front of a large audience and that, within reason, they are allowed to present on topics of interest to them. I also feel that the practice of interrupting student presentations, and of giving only negative feedback, should be changed as quickly as possible. A better situation would be one where students could be in a state of 'Relaxed attention in anticipation of reward'; this, according to neurologist Andrew Curran (see Chapter 5), creates the right mix of neurochemicals for learning.

In *Moving towards autonomy in learning*, Boud states that what is important in helping students achieve autonomy 'Is the attitude of teachers towards their students … an attitude of acceptance and appreciation of the views, desires and frames of reference of learners. Perhaps the single central quality which fosters autonomy is the quality of the relationship between teachers and learners which develops through this acceptance' (1981, p 39). To judge by students' comments, such a conducive atmosphere was not always achieved, although it was in the Enzymes in Biotechnology and Disease unit.

The ways in which students referred to seminars and their assessment, involving aspects of peer assessment and/or assessment of students' contribution to class discussions, left me confused about the objectives of seminars. It might be helpful to staff and students if the Department considered their seminar units from aims and objectives to assessment methods and feedback, with a view to achieving what John Biggs called 'constructive alignment' (1996) and Dai Hounsell 'congruence' (2005).

<u>Recommendations on final year projects</u>

- If practical classes were changed to give students better preparation for placement work, this would also act as preparation for project work and go some way towards reducing the disadvantage that non-placement students currently experience compared to their post-placement peers.

- The Department might like to provide additional support for non-placement students who may need it at the start of their projects.

- Projects should involve a limited number of laboratory techniques if students are to master them and develop the ability to work independently.

- The Department may like to monitor the amount of time students spend on their project work. Is it currently too much and stress-inducing? Do students have enough time for reflection?

- If students should not be working alone in the laboratories, this rule may need to be restated from time to time.

- The Department might like to consider the impression that some of its laboratories have on students; those seen as overcrowded and disorganised could adversely effect the Departments' reputation.

When it comes to final year projects, non-placement students are disadvantaged, compared to their post-placement peers, because university practical classes 'Do not prepare you for "real" lab work'. As a consequence, they felt they were 'Chucked in there' and found the experience 'Nerve-racking'. Perhaps this should be recognised and non-placement students given more support than has so far been the case and projects involving a limited number of new techniques. Otherwise the answer to '*Did you learn a lot*' from projects may continue to be 'No' or 'It hasn't' really stuck … so rushed'.

Post-placement students sometimes had considerable laboratory experience, often including independent research. They were generally comfortable with their projects and, being less needy, with the level of supervision. L9 felt she gained little from her project 'Considering on placement we're working for a whole year compared to 10 weeks on the project' but L4 and L19, both of whom were Masters students, said they benefited from their more challenging projects through doing more independently.

An unexpected outcome from research into project learning was the impression that some post-placement students had formed of some of the Department's laboratories as being 'Overcrowded and disorganised' and 'An untidy, disorganised mess'. The Department may wish to address this unfavourable impression.

<u>Workload, Assessment, Feedback and student stress</u>

There is general agreement, across the sector, that assessment load to be addressed. Generally, though, this refers to staff workload, rather than the workload experienced by students. My data suggest that fewer assessments for students would be likely to have a beneficial effect on their stress levels and that this might have a beneficial effect on student learning. Fewer assessments could be achieved if the compulsion to take subjects seen as

irrelevant was dropped (as recommended above) and students were allowed to attend fewer lecture and practical courses.

Exam stress could perhaps be reduced by first year study skills classes and by telling students what to expect from exams in their first year or when unfamiliar formats are introduced, as with Data Interpretation and Integrated MCB in the final year. Exams where students have plenty of time are likely to be less stressful than rushed ones and may help to address the belief that some exams were a test of writing speed. Assessment methods other than exams should perhaps be encouraged, e.g. Practical Molecular Biology, where assessment was by workbook and interview, (while avoiding the serious pitfalls of some student seminars, mentioned above).

With fewer assessment tasks it should be easier to provide better feedback, guiding students towards potential improvement. A change may be underway for final year students but is needed 'From the beginning!' in order to help students improve the standard of their work. As Tharp and Gallimore reported in 1988, 'Feeding back information on performance is a powerful means of assistance. On an experimental level, it often seems a sufficient means. Mere feedback frequently is enough to guide a student to substantial improvement in performance on the next try' (p 54).

Students' stress levels seemed to be high in their second and, particularly, final years and sometimes reached damaging levels. Some of the problems were caused by timetabling and the Department might like to look at this matter from the point of view of students living off campus. Further problems arose from the amount of time required by final year project work; it may be that project supervisors were setting more work than could be completed in the two or three days 'espoused' by the Department. In addition, perhaps the amount of background reading that students are given should to be reduced to below a level at which they opt out altogether; 'Overwhelming … you don't want to read any!' It might be better to follow the example of Neuro-development where a few review articles were recommended and some primary papers available for those who wanted to read in more detail.

Louise Grisoni's work links high anxiety with reduced independence in what she calls the Boomerang Effect; it suggests that, if one of the aims of degree programmes is student autonomy, then students should not be over stressed (Grisoni 2004).

Significance of this research to the rest of the University of Bath: further recommendations

<u>Placements</u>

The research into placement learning is likely to have relevance in other Departments which arrange placements. The University's Placement Tutors Forum could be used to disseminate the ideas in this thesis and placement teams might decide to study their own students' experiences and the espoused theories and theories-in-use in their own Departments. If they

have not done so already, they might decide to espouse a broader theory of placements than merely skills acquisition.

Subject relevance

Other programmes, in other faculties, may contain subjects which students see as having no relevance and where there is therefore potential for the University to save time and resources by reducing student numbers in lectures and/or practical classes. In order to find out there would need to be discussion with students about what was good, what was poor and how to make improvements to their programme; I believe this sort of research is long overdue. If the phrase 'waste of time' emerged it would need to be taken seriously and not dismissed with a 'university knows best' response. After all, when a professor writes that something is a waste of time, we are inclined to believe that his or her opinion is based on wisdom and experience. Students have a lot of experience and some wisdom about their learning and, from a constructivist standpoint, only they can say whether or not a given learning opportunity has value for them.

Learning and Teaching

My brief enquiry into academic staff perceptions of learning to teach at the University of Bath suggested that this too would be a fruitful area for research. The sheer amount of documentation involved, coupled with the lack of time available for reading and learning, and the feeling that the system recently in use was 'Patently and manifestly a total waste of time' suggests that there could have been savings here if less was done but done more effectively. I suggest that learning to teach at the University of Bath be examined from the point of view of the learners (academics-as-learners) involved.

Institutional ethos

The participant who felt that University of Bath students were 'Lowly undergraduates - we're a burden that they have to lecture to … not important' is probably not in the right frame of mind to learn easily. In addition, and perhaps of some concern to the University, a student with this view of his Alma Mater, is unlikely to contribute generously to alumni funds in future. The University may wish to ensure that its undergraduates feel valued for the sake of both student learning and future university revenue. I think it likely that, if students felt they had a voice and that their views counted and were acted upon, the University would be well on the way towards a better relationship with its student body.